

# Studies in *Pseudocyphellaria* (Lichens) IV\*. Palaeotropical species (excluding Australia)

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**SYNOPSIS.** Twenty-nine species of *Pseudocyphellaria* are recorded from the palaeotropics (from Africa to the eastern Pacific but excluding Australia) viz., *P. argyracea*, *P. aurata*, *P. beccarii*, *P. carpoloma*, *P. clathrata*, *P. crocata*, *P. crocatoides*, *P. desfontainii*, *P. dissimilis*, *P. dozyana*, *P. gilva*, *P. godeffroyii*, *P. haywardiorum*, *P. homalosticta*, *P. insculpta*, *P. intricata*, *P. maculata*, *P. multifida*, *P. neglecta*, *P. pickeringii*, *P. poculifera*, *P. prolificans*, *P. punctularis*, *P. reineckeana*, *P. rigida*, *P. semilanata*, *P. stenophylla*, *P. sulphurea* and *P. trichophora*. Details of their anatomy, chemistry, morphology and distribution are presented together with a key. The following new combinations are proposed: *P. beccarii* (Kremp.) D.J. Galloway and *P. trichophora* (Vain.) D.J. Galloway.

## INTRODUCTION

Species of *Pseudocyphellaria* are conspicuous, leafy, foliose lichens best developed and with richest biodiversity in rainforest, shrubland and successional vegetation, or subalpine and alpine grassland habitats of the Southern Hemisphere cool temperate zone, with major areas of speciation being New Zealand (Galloway, 1988) and southern South America (Galloway, 1992). In tropical regions *Pseudocyphellaria* is most commonly found in montane or mossy cloudforest between 1600 and 3600 m (see discussion on altitudinal zonation in Sipman (1993)), but several widespread species such as *P. aurata*, *P. crocata* and *P. intricata* occur at lower altitudes and in lowland and coastal sites as well. The contribution of species of *Pseudocyphellaria* to the 'Lobarion' alliance in south-east Asian forests is discussed in Wolseley (1991).

During a study of Australian species of *Pseudocyphellaria* (in preparation) very many collections from neighbouring areas in the Pacific Basin were examined, so that it is now possible to present a preliminary revision of palaeotropical species. Neotropical taxa in *Pseudocyphellaria* are discussed in accounts of Ecuadorian (Galloway & Arvidsson, 1990) and Brazilian (Galloway, 1993) collections, and in catalogues of Central American (Imshaug, 1956a), Mexican (Imshaug, 1956b) and West Indian (Imshaug, 1957) lichens. Earlier accounts discussing or listing palaeotropical taxa referable to *Pseudocyphellaria* include: Montagne (1856), Krempelhuber (1875), Zahlbruckner (1908, 1943), Vainio (1913, 1924), Magnusson (1940), Zahlbruckner & Mattick (1956), Szatala (1956), Joshi & Awasthi (1982), Hawksworth & Shaw (1984), Streimann (1986) and Swinscow & Krog (1988).

The context of palaeotropics used in the present account refers to all land in the tropical-subtropical zone outside of the neotropical region, viz., from Africa to the eastern Pacific bordering North, Central and South America and lying roughly between the tropics of Cancer and Capricorn at latitudes 35° north and south of the equator.

Species of *Pseudocyphellaria* discussed in this revision are

generally conspicuous lichens, some often reaching a great size and being among the largest and most rapidly growing of foliose lichens. They grow on twigs, bark, soil, or rock, often over or intermingled with bryophytes or other lichens in a wide variety of habitats. Since all taxa contain cyanobacteria either as a primary photobiont or as internal cephalodia they are efficient nitrogen fixers and important contributors to rainforest nitrogen budgets, a role which is of importance in the maintenance of rainforest biodiversity (Galloway, 1994). Detailed accounts of anatomical, morphological and chemical characters useful in species delimitation in the genus are given in Galloway (1988, 1992) and are not repeated here. The importance and possible role of triterpenoids in *Pseudocyphellaria* are discussed by Galloway (1991) and Wilkins (1993).

The undoubted importance of species of *Pseudocyphellaria* in a variety of tropical ecosystems makes a modern account of this genus a vital necessity. However, in offering this present revision as a contribution to tropical lichenology I must admit to its being almost entirely a herbarium study. I have collected only briefly from Peninsular Malaysia in the palaeotropics and consequently have not had the advantage of assessing variation in the field. Accordingly, I have taken a rather broad view of the limits of taxa and in widespread species, such as *P. argyracea*, *P. crocata*, *P. gilva*, *P. intricata* and *P. sulphurea* for example, I accept a wide morphological variation which seems acceptable based on the variation of these taxa in temperate habitats. It is hoped that the present revision will form a working baseline to the genus in the tropics and encourage lichenologists to undertake closer regional studies of it.

Type and other material was obtained from or examined in the following herbaria: AK, B, BM, BR, BSIP, CBG, COLO, E, G, GB, H, H-ACH, H-NYL, KEP, KLU, L, LD, LG, M, MEL, NY, PC, PC-LENORMAND, PC-THURET, S, TNS, TUR-VAINIO, UKMB, UPS, UPS-THUNBERG, UPSV, US, WU and from the following private herbaria: Dr A. Aptroot (Baarn), Dr L. Arvidsson (Göteborg), Prof. G. Degelius (Askim) [Prof. Degelius's lichens are now at UPS], Dr P. Diederich (Luxembourg), Dr K. Kalb (Neu- markt), and Prof. C.W. Smith (Honolulu).

\* Part III In *Bibliotheca Lichenologica* 46: 1–275 (1992).

## SYSTEMATIC TREATMENT

Key to palaeotropical species of *Pseudocyphellaria*

- 1 Medulla white ..... 2  
Medulla yellow ..... 26
- 2 Photobiont green ..... 3  
Photobiont blue-green ..... 9
- 3 Pseudocyphellae white ..... 4  
Pseudocyphellae yellow ..... 4. *P. carpoloma*
- 4 Pseudocyphellae present on upper surface ..... 5  
Pseudocyphellae not present on upper surface ..... 6
- 5 Isidiate-phyllidiate ..... 15. *P. homalosticta*  
Without isidia or phyllidia ..... 24. *P. reineckeana*
- 6 Without isidia or lobules ..... 7  
Isidiate/lobulate ..... 8
- 7 Lobes broad, punctate-impressed ..... 28. *P. sulphurea*  
Lobes narrow ..... 27. *P. stenophylla*
- 8 Lobes broad, rounded, phyllidiate ..... 18. *P. multifida*  
Lobes narrow, punctate-impressed ..... 22. *P. prolificans*
- 9 Pseudocyphellae white ..... 10  
Pseudocyphellae yellow ..... 21
- 10 With soredia or isidia ..... 11  
Without soredia or isidia ..... 16
- 11 Sorediate ..... 12  
Isidiate/phyllidiate ..... 15
- 12 Upper surface smooth or punctate-impressed; 2 hopanes present ..... 13  
Upper surface faveolate or punctate-impressed; hopane triol present ..... 11. *P. dozyana*
- 13 Upper surface plane or undulate; pseudocyphellae on lower surface rare or absent ..... 16. *P. intricata*  
Upper surface punctate-impressed; pseudocyphellae on lower surface prominent ..... 14. *P. haywardiorum*
- 14 Isidiate ..... 14  
Phyllidiate ..... 9. *P. insculpta*
- 15 Isidia associated with pseudocyphellae ..... 1. *P. argyracea*  
Isidia not associated with pseudocyphellae ..... 10. *P. dissimilis*
- 16 Pseudocyphellae present on upper surface ..... 17  
Pseudocyphellae absent on upper surface ..... 3. *P. beccarii*
- 17 Isidia absent ..... 18  
Isidia or marginal lobules present ..... 23. *P. punctillaris*
- 18 Upper surface plane ..... 19  
Upper surface scrobiculate ..... 25. *P. rigida*
- 19 Upper surface smooth, not areolate-scabrid ..... 20  
Upper surface areolate-scabrid ..... 13. *P. godeffroyii*
- 20 Margins of lobes tomentose-hairy ..... 29. *P. trichophora*  
Margins of lobes glabrous ..... 26. *P. semilanata*
- 21 Sorediate or isidiate/phyllidiate ..... 22  
Without soredia or isidia ..... 25
- 22 Isidiate/phyllidiate ..... 23  
Sorediate ..... 6. *P. crocata*
- 23 Phyllidiate or with marginal or laminal proliferations ..... 24  
Isidiate ..... 8. *P. desfontainii*
- 24 With laminal and marginal proliferations, not truly phyllidi-

- ate ..... 7. *P. crocatoides*  
Phyllidiate ..... 19. *P. neglecta*
- 25 Upper surface deeply faveolate ..... 17. *P. maculata*  
Upper surface undulate ..... 12. *P. gilva*
- 26 Sorediate or isidiate/phyllidiate ..... 27  
Not sorediate, isidiate or phyllidiate ..... 5. *P. clathrata*
- 27 Sorediate ..... 28  
Isidiate/phyllidiate ..... 20. *P. pickeringii*
- 28 Soralia linear, confluent, labriform ..... 2. *P. aurata*  
Soralia derived from small, marginal, crowded isidia ..... 21. *P. poculifera*

## The species

1. *Pseudocyphellaria argyracea* (Delise) Vain. in *Hedwigia* 37: 35 (1898). *Sticta argyracea* Delise in *Mém. Soc. linn. Normandie* 2: 91 pl.7, fig. 30 (1825). *Stictina argyracea* (Delise) Nyl., *Syn. meth. lich.* 1(2): 334 (1860). *Cyanisticta argyracea* (Delise) Gyeln. in *Reprum Spec. nov. Regni veg.* 29: 2 (1931). Type: Ile de la Réunion. Sur des troncs ou les rochers mousses des hautes régions, ?*Bory de St-Vincent*, ex Herb. Bory (PC-THURET-lectotype (Galloway & James, 1986: 429)).
- Sticta argyracea* var. *sorediifera* Delise in *Mém. Soc. linn. Normandie* 2: 92 pl.7, fig.31 (1825). *Stictina argyracea* var. *sorediifera* (Delise) Nyl., *Syn. meth. lich.* 1(2): 334 (1860). *Pseudocyphellaria argyracea* var. *sorediifera* (Delise) Malme in *Bih. K. svenska VetenskAkad. Handl.* 25(3/6): 24 (1899). Type: Madagascar, without specific locality, collector or date (PC-LENORMAND-lectotype (Galloway & James, 1986: 430)).
- Sticta boryana* Delise in *Mém. Soc. linn. Normandie* 2: 102 pl.8, fig. 37 (1825). *Pseudocyphellaria boryana* (Delise) D.J. Galloway in *Lichenologist* 17: 303 (1985). Type: Ile de Bourbon [Réunion], Plaine de Chicots, sur le bois mort des forêts montagneuses, *Bory de St-Vincent* s.n. (PC-THURET-holotype).
- Sticta rigidula* Delise in *Mém. Soc. linn. Normandie* 2: 97 pl. 8, fig. 34 (1825). *Stictina argyracea* f. *rigidula* (Delise) Nyl. in Hue, *Nouv. Archs Mus. Hist. nat. Paris* III, 2: 295 (1890). *Sticta argyracea* f. *rigidula* (Delise) Zahlbr., *Cat. lich. univ.* 3: 371 (1925). *Cyanisticta rigidula* (Delise) C.W. Dodge in *Beih. nov. Hedwigia* 12: 178 (1964). Type: Ile de Bourbon [Réunion], sur l'écorce, *Bory de St-Vincent* s.n. (PC-THURET-lectotype (Galloway & James, 1986: 432)).
- Sticta flavescens* Delise in *Mém. Soc. linn. Normandie* 2: 117 pl. 11, fig. 47 (1825). *Stictina argyracea* var. *flavescens* (Delise) Nyl. in Hue, *Nouv. Archs Mus. Hist. nat. Paris* III, 2: 295 (1890). *Sticta argyracea* var. *flavescens* (Delise) Zahlbr., *Cat. lich. univ.* 3: 372 (1925). *Cyanisticta flavescens* (Delise) C.W. Dodge in *Beih. nov. Hedwigia* 12: 173 (1964). Type: Ile de Bourbon [Réunion], sur l'écorce, *Bory de St-Vincent* (PC-THURET-holotype).
- Sticta aspera* Laurer in *Linnaea* 2: 41 (1827). *Sticta argyracea* var. *aspera* (Laurer) Kremp. in *Verh. zool.-bot. Ges. Wien* 18: 316 (1868). *Stictina argyracea* var. *aspera* (Laurer) Müll. Arg. in *Revue mycol.* 9: 138 (1887). *Cyanisticta aspera* (Laurer) C.W. Dodge in *Beih. nov. Hedwigia* 12: 170 (1964). Type: Mauritius, *Sieber* 40 (L 910,215-1683-lectotype (Galloway & James, 1986: 430)).

*Stictina argyracea* f. *insidiata* Nyl. in *Cromb., J. Linn. Soc. (Bot.)* 15: 435 (1876). *Sticta argyracea* f. *insidiata* (Nyl.) Zahlbr., *Cat. lich. univ.* 3: 371 (1925). Type: Ins. Rodriguez, I.B. Balfour 2279 (H-NYL 34058-holotype; BM-isotype). (The holotype material in Nylander's herbarium is a small scrap taken from a larger collection in Crombie's herbarium (BM) which is preserved as two separate specimens, only one of which is numbered 2279. All three specimens are labelled 'f. *insidiata* Nyl.' and not *insidiata* as appears in the protologue.)

*Cyanisticta javanica* Gyeln. in *Reprrium Spec. nov. Regni veg.* 29: 297 (1931). Type: Java, Prov. Preanger, in monte ignivomo Papandayan, 1750 m, Schiffner 3309 (L 956.124 594-isotype).

*Pseudocyphellaria horridula* H. Magn. in H. Magn. & Zahlbr., *Ark. Bot.* 31A: 82 (1943). *Cyanisticta horridula* (H. Magn.) Szatala in *Annl. hist.-nat. Mus. natn. hung.* 7: 41 (1956), comb. inval. Type: Hawaii ad truncos muscosos in paludosis ad Waimea, 4000', J.F. Rock 6 (W-isotype).

*Pseudocyphellaria horridula* var. *excrescens* H. Magn. in H. Magn. & Zahlbr., *Ark. Bot.* 31A: 83 (1943). Type: Hawaii. Maui, Iao Valley, Faurie 566 (W-not seen).

*Pseudocyphellaria argyracea* is a characteristic, laminally pseudocyphellate, pseudoisidiate, white-medulla species which is widespread in the palaeotropics from the Indian Ocean islands to the Pacific basin as far east as the Galapagos Islands (Weber, 1986) and as far south as New Zealand (Galloway, 1988) and southern Chile (Galloway, 1992). Typification of this species is discussed by Galloway & James (1986) and a detailed account of the morphology and anatomy is given in Galloway (1988: 64–68).

**CHEMISTRY.** Methyl gyrophorate, gyrophoric acid, 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

**OBSERVATIONS.** *Pseudocyphellaria argyracea* is slatey grey-blue to blue-black, often tinged red-brown when wet, pale grey to grey-brown when dry; it has a white medulla, a cyanobacterial photobiont and white pseudocyphellae on both upper and lower surfaces. It is characterized by numerous, evenly spaced, laminal, white pseudocyphellae which at maturity become pseudoisidiate with corticate, fingerlike pseudoisidia, concolorous with the thallus, developed in clusters, some of which may become abraded and appear granular-sorediate. New isidia often develop from older abraded structures. Superficially *P. argyracea* resembles some broad-lobed forms of *P. intricata* but differs in the pseudoisidiate clusters associated with the laminal pseudocyphellae. The taxon *P. boryana* (Galloway, 1985b; Galloway & James, 1986: 432–3) has narrower, more dissected,  $\pm$  dichotomously branching lobes and distinctive, marginal proliferations, the laminal pseudocyphellae of which are not sorediate or associated with isidia. However, it seems only to be an extreme form of *P. argyracea* and is therefore placed in synonymy with this species.

**DISTRIBUTION AND ECOLOGY.** *Pseudocyphellaria argyracea* is a widespread palaeotropical taxon (Fig. 1), extending from East Africa (Swinscow & Krog, 1988) to southern South America (Galloway, 1992) northwards to India (Awasthi, 1965, 1988), China (Wei, 1991) and Japan (Yoshimura, 1974), and southwards to New Zealand (Galloway, 1988). On bark of saplings and small trees and on mossy trees, rotting logs in humid, shady montane and cloud forest, often in crowns of trees, from 700 to 3650 m. Also at lower elevations in coastal sites.

**SPECIMENS EXAMINED.** **Africa. Tanzania:** Tanga. Usambara Mountains, Amani, Santesson 23370 (UPS); *ibid.*, *Brunnthaler* (W, WU); Nazumbei, *Brunnthaler* (WU); Ukaguru Mts, road from Mandege Forest Station to Rubeho, Pocs, Harris

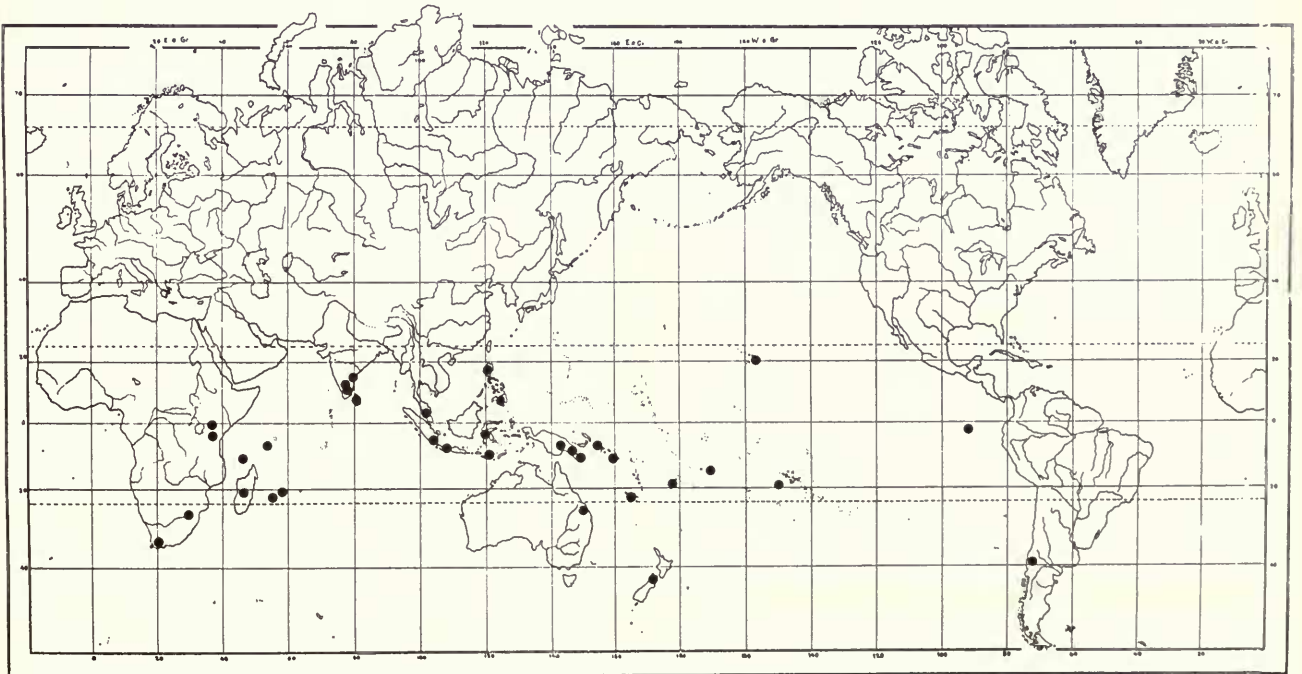


Fig. 1 Distribution of *Pseudocyphellaria argyracea* in the palaeotropics.

& *Mwanjabe* 6588 (BM); Uluguru Mts, Mwere Valley, *Pocs, Farkas, Geissler, Iversen, Steiner & Tenu* 86158 (BM). **Uganda:** Masaka, Nanuzinna swamp, *Lye* L 640 (BM); Kigezi, Kinkizi, *Swinscow* 3U 56/5 (BM). **Kenya:** Mt Kenya, 200–2100 m, *Swinscow* K48.34A, K 51/3 (BM). **South Africa:** **Transvaal.** Drakensberge, *Werdermann & Oberdieck* 1849 (B). **Comoro I:** Anjouan, M'Tingui Peak, *Benson* 183 (BM). **Madagascar:** ?Andrangoloaka, ?Likora (W); sine loco, *Herb. Persoon* (L); *Roxburgh* (BM); sine loco, *Lam en Meeuse* 5966 (L). **Mauritius:** sine loco, *Robillard* (W); [ISO-TYPE] *Sieber* 40 (W); *McGregor* 1819 (BM); *Vacquois, Ayres* (BM). **Réunion:** sine loco, *Richard* (H-NYL 34064); Cirque de Salazie, *K. & A. Kalb* 26560, 26561, 26564 (Herb. Kalb); Cirque de Cilaos, *de Sloover* 17.463 (LG). **Seychelles:** Silhouette, *Gardiner* 1905 (BM). **Rodriguez Is:** *Balfour* 2279 (BM). **Sri Lanka:** Nuwara Eliya, *Meltzer* s.n. (Herb. Aptroot); Rampoode, *Almquist* (H-NYL 34065); *v. Beusekom* 290 (Herb. Aptroot); Habgalla, *Thwaites* (BM); above Pattipola, Horton Plains, *van Steenis* 19924c (L). **Thailand:** Nakhon Sawan, *Touw* 8237 (Herb. Aptroot). **Malaysia:** **Pahang.** Fraser's Hill, *Dransfield* 481 (BM); Fraser's Hill, *Burkill* 2084 (L); Fraser's Hill, *Galloway* (BM, KEP, KUL). **Indonesia.** **Sumatra:** sine loco, *Korthals* (L). **Java:** Tjibodas, *Koernich* 2a (Herb. Aptroot); *Arvidsson & Nilsson* (GB); Mt Kawi, Mt Panderman, *Groenhart* 1931, 1936, 2632 (L); Mt Gede, *Schiffner* 3289b (L); sine loco, *Junghuhn* (L); Mt Ardjuno, *Groenhart* 29, 668, 1531, 1988, 7332 (L); Mt Lawu, *Clason* 986 (L); Mt Wilis, *Groenhart* 1537, 1838 (L); Mt Pangerango, *Schiffner* (WU). **Flores:** sine loco, *Verheijen* 5201 (Herb. Aptroot). **Sulawesi:** sine loco, *De Vriese* (L). **Philippines:** **Luzon.** Pampanga. Mt Pinatubo, *Elmer* 22270 (B, BM). **Mindanao.** Butuan, *Weber* 1352 (US); Rizal, 1911, *Ramos* 13634 (BM); sine loco, *Cumming* 2156 (BM). **Papua New Guinea:** **Eastern Highlands.** Chimbu. Mt Wilhelm, *Weber & McVean* (Herb. Aptroot L54979, COLO); *Aptroot* 18235, 18333, 18651, 32786 (Herb. Aptroot); *Kashi-*

*wadani* 10882, 10924, 11188, 11199, 11410, 11418 (TNS); *Wade* (COLO); *McVean* 66182 (CBG); track to Mt Wilhelm, *Sipman* 21923 (B); Pindaunde Valley, *Sipman* 15905, 15906, 22098 (B); Goroka. Mt Gahavisuki Provincial Park, *Aptroot* 32420 (Herb. Aptroot); *Streimann* 18215 (CBG); Daulo Pass, *Streimann* 18110 (CBG). **Morobe.** Lake Wamba, *Koponen* 33406 (Herb. Aptroot); Mt Kaindi, *Weber & McVean* (COLO); *Streimann & Bellamy* 17665 (CBG); Herzog Mountains, *Streimann & Umba* 11015 (CBG); Gumi Divide, *Streimann* 22761 (CBG); Ekuti Divide, *Streimann* 20147 (CBG). **Southern Highlands.** Margarima, *Streimann* 24393 (CBG); Munie Logging Area, *Streimann* 23674 (CBG); Onim Forestry Station, *Streimann* 24649 (CBG); Iaro River, *Streimann* 23979 (CBG). **Milne Bay.** Woodlark Island, *Kumei* 57, 71 (CBG). **Central.** Mt Albert-Edward, *Kashiwadani* 12002 (TNS). **Western Highlands.** Tumbang Village, *Streimann* 21351, 21371 (CBG). **Solomon Islands:** **Guadalcanal Island.** Mt Popomansiu, *Hill* 9314, 9523, 9563, 9690, 9704, 9853 (BM). **Bougainville.** Lake Luralu, *Kajewsky* 1930 (BM). **New Caledonia:** Rivière Bleue, *Hill* 11689 (BM); Rivière Blanche, *Hill* 11699 (BM). **Fiji:** **Viti Levu.** Nandarivatu, *Green* (BM). **Tahiti:** sine loco, *Viellard & Panchon* (H-NYL 34064); Aorai, *v. Balgooy* (Herb. Aptroot). **Hawaiian Islands:** **Hawaii.** Waimea, *Rock* [Lichenes Sandwicensis No.6] (W). **Kauai.** Kaholnamano, *Rock* [Lichenes Sandwicensis No.11] (W). **Oahu.** Central Waianae Mts, Waianae Kai Forest Reserve, Honua Stream, *Smith* 1611 (Herb. Smith); Honouliuli Forest Reserve, Puu Kaua, *Smith* 4126 (Herb. Smith); trail to Puu Kalena, *Smith* 1549a (Herb. Smith); Koolau Mts, Koolauloa District, Kahana Valley, *Vitt* 14691 (H). **Galapagos Islands:** *Isla Pinzou.* *Sipman* L106 (COLO).

2. *Pseudocyphellaria aurata* (Ach.) Vain. in *Acta Soc. Fauna Flora fenn.* 7: 183 (1890). *Sticta aurata* Ach., *Methodus*: 277 (1803). Type: ? England, Devon, without specific locality, ex Herb. Hudson-label incomplete (H-ACH)

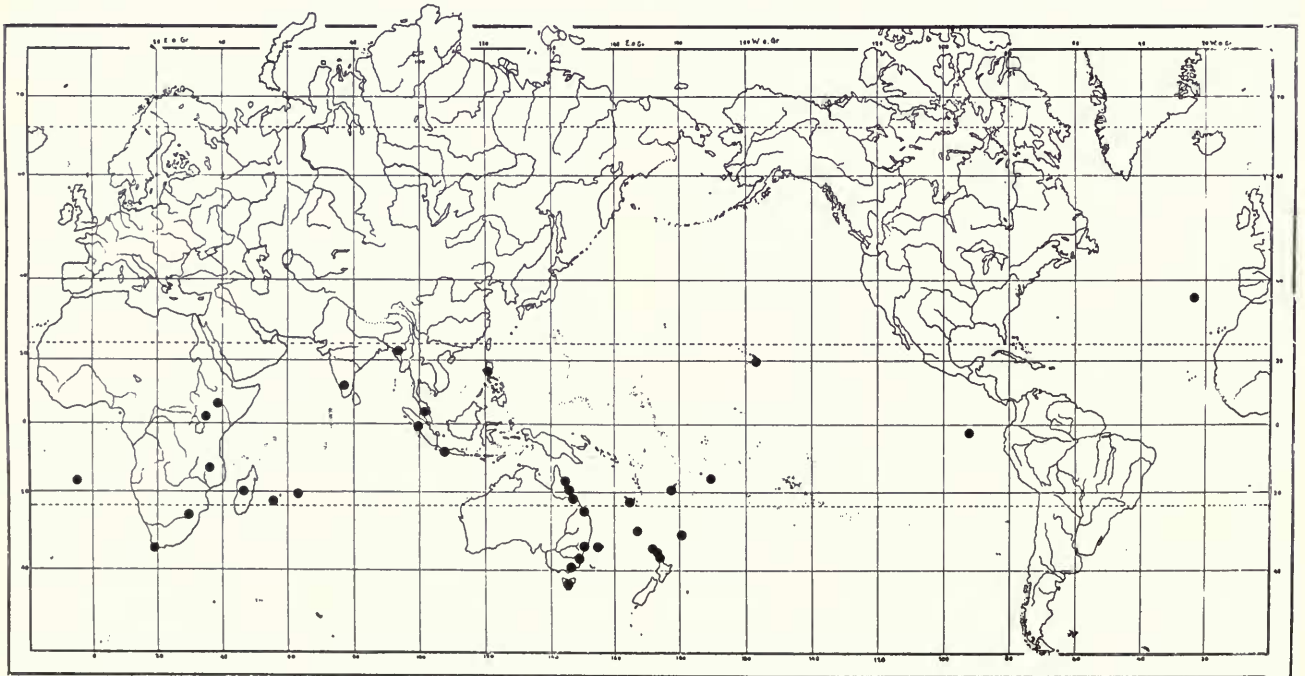


Fig. 2 Distribution of *Pseudocyphellaria aurata* in the palaeotropics.

1534-holotype). For additional synonymy see Galloway (1988).

*Pseudocyphellaria aurata* is bright lettuce-green tinged yellow-gold when wet, pale green-grey, often tinged or becoming reddish on storage when dry; it is a characteristic, yellow-medulla species which is widespread in tropical regions of the world, for example in Ecuador (Galloway & Arvidsson, 1990: 116–118) and is also found in drier, warmer, coastal areas in cool temperate regions, particularly in the Southern Hemisphere where it is known from New Zealand (Galloway, 1985a, 1988), eastern Australia and Chile (Galloway, 1992). Palaeotropical material closely approximates in both anatomy and morphology the description given in Galloway (1988: 68–69).

**CHEMISTRY.** Pulvinic acid, pulvinic dilactone, calycin, 3 $\beta$ -acetoxyfern-9(11)-en-12-one, 3 $\beta$ -acetoxyfern-9(11)-en-12 $\beta$ -ol, fern-9(11)-ene-3 $\beta$ , 12 $\beta$ -diol, 3 $\beta$ -acetoxyfern-9(11)-en-19 $\beta$ -ol, 3 $\beta$ -hydroxyfern-9(11)-en-12-one, lupeol acetate (Wilkins & Elix, 1990).

**OBSERVATIONS.** *Pseudocyphellaria aurata* is a cosmopolitan species having a yellow medulla, a green photobiont, yellow pseudocyphellae on the lower surface, and prominent, marginal, labriform,  $\pm$  linear yellow soralia, that often erode back the lower surface and contain coarse, granular yellow soredia. Apothecia rather rare, submarginal, distinctly pedicellate, exciple concolorous with thallus, margins ragged, yellow-sorediate. Spores brown, broadly fusiform-ellipsoid, 3-septate (25-)30–32  $\times$  6–7  $\mu$ m.

**DISTRIBUTION AND ECOLOGY.** *Pseudocyphellaria aurata* occurs on trees, shrubs and rocks in both open, sunny sites as well as in the forest canopy and on branches and twigs in moderate shade in montane forests. From sea level to 2300 m. Widespread in the tropics (Fig. 2) and in cool temperate regions (Galloway, 1988, 1992; Galloway & Arvidsson, 1990).

**SPECIMENS EXAMINED.** **Africa. Tanzania:** Arusha National Park. Mt Meru, *Renvoize* 2493c (BM). **Kenya:** Mt Marsabit, *Lye* (BM). **Uganda:** Lake Mulehe, *Swinscow* (BM). **Malawi:** Zomba Plateau, *Jellicoe* (BM). **South Africa: Cape Peninsula.** Hout Bay, *Maas Geesteranus* 14659 (Herb. Aptroot); near Knysna, *Werdermann & Oberdieck* 913b (B); Cape of Good Hope, *Ecklon* (B); Table Mt, *Eaton* (BM). **Natal. Sim** (BM). **Transvaal.** Kowyns Pass near Graskop, *Sipman* 19.926 (B); Long Tom Pass, *Sipman* 20.094 (B); Drakensberge, *Werdermann & Oberdieck* 1855 (B). **Madagascar:** Imarina, *Cowan* (BM). **Réunion:** sine coll. (BM); southern slope of Piton des Niegues, near Cilaos, *Arvidsson & Nilsson* 2536 (GB); Cirque de Cilaos, *de Sloover* 17.471, 17.473, 17.631, 17.780 (LG). **Rodriguez I: Balfour** (BM). **Malaysia: Pahang.** Fraser's Hill, *Dransfield* 517 (BM); Fraser's Hill, *Galloway* (BM, KEP, KLU); Cameron Highlands, Tanak Rata, *Degelius* As-547, As-550 (UPS). **Indonesia. Sumatra:** Bukittinggi, *Hensen* (Herb. Aptroot). **Java:** Tjibodas, *Koernich* 2b (Herb. Aptroot). **Philippines: Luzon.** Benguet. Mt Santo Tomas, *Aptroot* 20449 (Herb. Aptroot); *Sipman* 21751 (B); Bagoio, Luneta Hill, *Degelius* As-905 (UPS). **New Guinea: Morobe.** Edie Creek Road, *Streimann* NGF 39103 (CBG); *v. Royen* NGF 16288 (Herb. Aptroot); Kwama River Valley, *Koponen* 33232 (Herb. Aptroot); Upper Watut River, *Streimann* 17072 (CBG); Herzog Mountains, *Streimann & Umba* 10988, 11137 (CBG); Honzeukngon village, *Aptroot* 17773 (Herb.

*Aptroot*); Pouyu Village, *Streimann & Tamba* 12575, 12693 (CBG); Upper Nawata Band, *Streimann* 33973 (CBG); Manki Trig, *Streimann & Bellamy* 12942 (CBG); Mt Susu, *Streimann* 34182 (CBG); Kauli Lake, *Streimann* 34099 (CBG); Mt Kaindi, *Streimann* 33418 (CBG). **Madang.** Finisterre Range. Teptep Village, *Aptroot* 32286 (Herb. Aptroot). **Eastern Highlands.** Lapegu, *Streimann* 18275, 18396, 18427, 18443 (CBG); Mt Michael, *Streimann* 18786 (CBG); Goroka. Mt Gahavisuki Nature Reserve, *Aptroot* 18848 (Herb. Aptroot). **Western Highlands.** Kagamuga, *Streimann* 21701 (CBG). **New Caledonia:** sine loco, *Compton* 716 (BM). **Norfolk Island:** Mt Pitt Reserve, Duncombe Road, *Streimann* 34595 (CBG); Broken Pine, *Elix* 18315 & *Streimann* (BM). **Kermadec I.: Cheeseman** (BM). **Hawaiian Islands: Oahu.** Waianae Mts, Honouliuli Forest Reserve. Puu Kaua, *Smith* 4126 (Herb. Smith); Waianae Kai Forest Reserve, Honua Stream, *Smith* 1611 (Herb. Smith). **Fiji: Viti Levu.** Nadarivatu. Nadala, *Degener* 31807b (B); District Commissioners House, *Degener* 31814ad (B); Mba, *Smith* 5965 (BM). **Samoa:** sine loco, *Powell* (BM). **Galapagos Islands: Isla Charles.** Trail from Black Beach to highlands, *Weber & Lanier* (COLO); *Weber* 328, 427 (COLO). **Isla Duncan.** Summit, *Cavagnaro* (COLO). **Isla Isabella.** Volcan Cerro Azul, *Sipman* L-67 (COLO); *Weber & Lanier* (COLO). **Isla San Cristobal.** West of El Junco, *Lanier* (COLO).

### 3. *Pseudocyphellaria beccarii* (Kremp.) D.J. Galloway, comb. nov.

Fig. 3.

Basionym: *Sticta beccarii* Kremp. in *Nuovo G. bot. ital.* 7: 11 (1875). *Stictina beccarii* (Kremp.) Müll. Arg. in *Flora, Jena* 65: 301 (1882). Type: Sarawak, *O. Beccari*, Lichenes Bornenses, No. 121, 1866 (M-lectotype, selected here; BM, M-isolectotypes).

*Stictina fragillima* var. *subpunctulata* Nyl. in *Leight.*, *Trans. Linn. Soc. Lond.* 27: 164 (1869). *Stictina subpunctulata* (Nyl.) Stizenb. in *Flora, Jena* 81: 138 (1895). *Sticta subpunctulata* (Nyl.) Hue in *Nouv. Arch. Mus. Hist. nat. Paris* IV, 3: 54 (1901). *Pseudocyphellaria subpunctulata* (Nyl.) Vain. in *Philipp. J. Sci. sect. C, Bot.* 8: 119 (1913). *Cyanisticta subpunctulata* (Nyl.) Szatala in *Annls hist.-nat. Mus. natn. hung.* 7: 41 (1956), comb. inval. Type: Ceylon, Central Province, *G.H.K. Thwaites* C.L. 22 (BM-lectotype, selected here).

*Stictina junghuhniana* Müll. Arg. in *Flora, Jena* 65: 300 (1882). *Pseudocyphellaria junghuhniana* (Müll. Arg.) D.D. Awasthi in *Beih. nov. Hedwigia* 17: 104 (1965). Type: In Insula Java, *Junghuhn* (L-910,215–1406-lectotype, selected here).

*Stictina junghuhniana* var. *laevis* Müll. Arg. in *Flora, Jena* 65: 300 (1882). *Stictina subpunctulata* var. *laevis* (Müll. Arg.) Stizenb. in *Flora, Jena* 81: 128 (1895). *Sticta subpunctulata* var. *laevis* (Müll. Arg.) Zahlbr., *Cat. lich. univ.* 3: 399 (1925). *Pseudocyphellaria junghuhniana* var. *laevis* (Müll. Arg.) D.D. Awasthi in *Beih. nov. Hedwigia* 17: 104 (1965). Type: Ceyloniae, in montanis cum forma genuina speciei, altit. circ. 6000-pedali, *Nieter* (G-not seen).

*Thallus* irregularly spreading in entangled clones, 8–15(–25) cm diam., loosely attached centrally, apices free, ascending. *Lobes* linear-elongate, 3–8(–15) mm wide, 1–5(–10) cm long,  $\pm$  dichotomously to irregularly branching, contiguous or discrete at margins,  $\pm$  imbricate centrally, apices divergent,

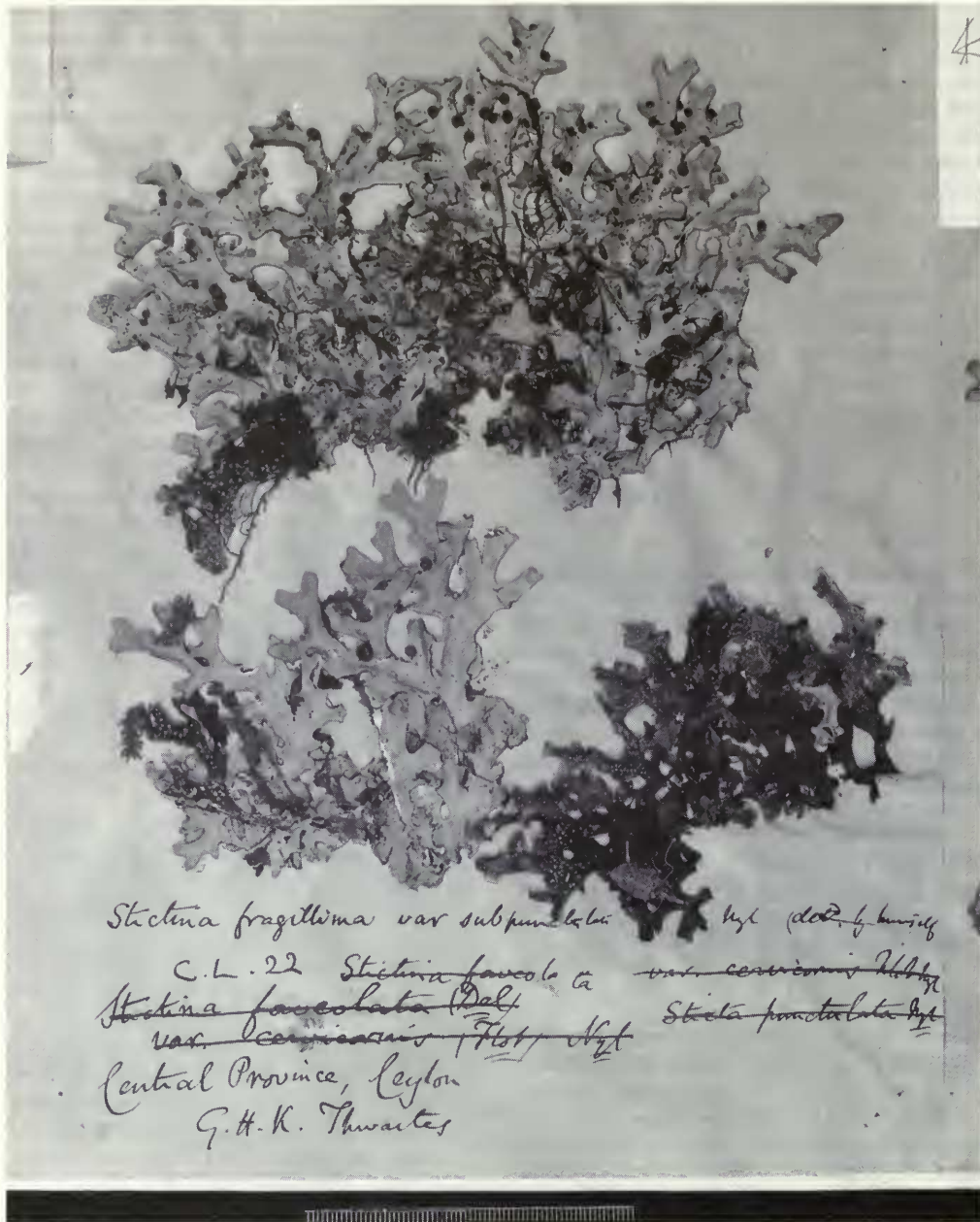


Fig. 3 *Pseudocyphellaria beccarii*. Lectotype *Stictina fragillima* var. *subpunctulata* (BM). Scale in mm.

rounded, truncate or sharply to bluntly furcate. Margins entire, noticeably thickened, ridged below and often conspicuously pseudocyphellate, very rarely with occasional small lobules developed. Upper surface dark grey-black or blue-black, suffused red-brown at apices, pale glaucous buff or greyish when dry, conspicuously deeply to shallowly punctate-depressed or dimpled, irregular to undulate or wrinkled, not faveolate, coriaceous, matt or shining in parts, maculate, without isidia, phyllidia, pseudocyphellae or soredia.

Medulla white. Photobiont cyanobacterial. Lower surface pale buff or whitish at margins, red-brown to black centrally or sometimes uniformly pale brown from margins to centre, irregularly wrinkled to  $\pm$  bullate, tomentum rather variable, from scattered thin patches centrally to densely and uni-

formly developed from margins to centre, pale buff or whitish to red-brown or blackened. *Pseudocyphellae* white, widely scattered to common and  $\pm$  crowded, round to irregular, 0.1–1(–1.5) mm diam., conical-verrucose, margins distinctly raised and sharply defined, concolorous with lower cortex, decorticate area flat to  $\pm$  concave, projecting above thin tomentum or usually sunk in thick tomentum, often  $\pm$  conspicuous at margins.

*Pycnidia* mainly marginal, crowded in lines, rarely scattered on upper surface, ostiole hemispherical brown-black, 0.1 mm diam.

*Apothecia* marginal or submarginal, rarely laminal, sparse to moderately frequent, rounded to subirregular, 2–5 mm diam., sessile to subpedicellate, exciple coarsely verrucose-scabrid, obscuring disc when young, pale buff to brown, disc

to dark red-brown, to  $\pm$  blackened, consistently darker than margin, concave at first, plane to subconvex at maturity, matt, smooth, epruinose. *Epithecium* pale yellow-brown, 12–15  $\mu\text{m}$  thick. *Hymenium* colourless, 100–115  $\mu\text{m}$  tall. *Ascospores* pale brown, 3-septate, ellipsoid, apices pointed,  $33.5\text{--}42.5$  ( $-44.5$ )  $\times$  (6.5–) 8.5–11  $\mu\text{m}$ .

**CHEMISTRY.** Tenuiorin, methyl gyrophorate, gyrophoric acid, 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

**OBSERVATIONS.** *Pseudocypbellaria beccarii* is characterized by a white medulla; a cyanobacterial photobiont; a dimpled, punctate-impressed upper surface;  $\pm$  dichotomously branching lobes with entire margins; scattered, flecklike white pseudocypbellae on the lower surface; and a two-hopane chemistry with tenuiorin, methyl gyrophorate and gyrophoric acid as accessory substances. It is distinguished from *P. insculpta* in the absence of marginal isidia and phyllidia, from *P. sulphurea* in having a cyanobacterial photobiont, and from *P. semilanata* which has scattered white pseudocypbellae on the upper surface.

**DISTRIBUTION AND ECOLOGY.** Widespread in the palaeotropics (Fig. 4), from Madagascar eastwards to Fiji and Samoa but not known from Hawaii. Also in north-eastern Australia. An epiphyte of montane rainforest and mossy cloudforest on trees and shrubs, 1500–2800 m.

**SPECIMENS EXAMINED.** **Madagascar:** sine loco, *Thompson* (M). **Sri Lanka:** sine loco, *Beccari* 12 [Crittogame di Ceylan No. 12] (M); Nuwara Eliya, ?*Blallu* 74 (W). **Burma:** sine loco, *Lobb* (BM). **Malaysi:** **Sabah.** Mt Kinabalu, *Sipman & Tan* 30960, 31084, 31377 (B); *Richards* (BM); *Clarke* 86 (BM). **Indonesia.** **Java:** Mt Ardjuno, *Groenhart* 1516, 1852, 1993, 1998, 2042, 4615, 7245, 7327, 7329 (L); Mt Kawi, *Groenhart* 1829, 1951, 1963, 7255 (L); Mt Lawu, *Clason* 982 (L); Mt Wilis, *Groenhart* 1538 (L); Batu, *Roomaker* 1985

(L); Mt Gede, *Groenhart* 7271 (L); Mt Megamendung, *Schiffner* 1159, 3351 (L, WU). **Kalimantan:** sine loco, *Beccari* (M). **Philippines.** **Luzon:** Benguet, Mt Pulog, *Jacobs* B47 (Herb. Aptroot); *Curran, Merritt & Zschokke* (US); Pauai, *McGregor* (E, US); Pampanga. Mt Pinatubo, *Elmer* 22270 (B, BM); Laguna. Mt Banajao, *Merrill* 7525 (US); Mt Malinao, *Edano* 37208 (L). **Mindoro:** Alag River, *Merrill* 5497 (US). **Papua New Guinea: Eastern Highlands.** Chimbu. Mt Wilhelm, *Sipman* 21959, 22137 (B); *Borgmann* 776, 896 (B); *Kashiwadani* 10845, 10917, 10965, 11080 (TNS); *McVean* 66149 (CBG); Lake Aunde, *Aptroot* 18466 (Herb. Aptroot); Pindaunde Valley, *Weber & McVean* (B, COLO); Goroka. Daulo Pass, *Streimann* 17989 (CBG). **Morobe.** Cromwell Mountains, Siwea, *Koponen* 30545 (Herb. Aptroot); Huon Peninsula, Mt Rawlinson, *Hoogland* 9315 (Herb. Aptroot, COLO); Mt Missim, *Bellamy* 203 (CBG); Ekuti Divide, *Streimann* 20121, 20168, 20187, 20212, 34148 (CBG); Wagau-Malolo Track, *Streimann* 19577 (CBG); Upper Watut River, *Streimann* 23137 (CBG); near Honzeukngon village, *Aptroot* 17998, 18041 (Herb. Aptroot); Rawlinson Range, *Strong Clemens* 12490 (COLO); Aiuwa-Bakia Track, *Streimann & Tamba* 12281 (CBG); Yinimba, *Streimann* 19710 (CBG); Mannasat, *Hoogland* 9466 (COLO). **Central.** Mt Albert-Edward, *Kashiwadani* 11748, 11770, 11816, 11982 (TNS). **Western Highlands.** Nebilyer River, *Streimann* 20599 (CBG); Mur Mur Pass, *Streimann* 21196, 22404 (CBG). **Southern Highlands.** Munie Logging Area, *Streimann* 23248, 23309, 23613, 23615 (CBG); Onim Forestry Station, *Streimann* 24639 (CBG); Enga. Mt Hagen-Wabag Road, *Streimann* 21256 (CBG). **Solomon Islands: Guadalcanal Island.** Mt Popomansiu, *Hill* 9290, 9560, 9572, 9632, 9694, 9706 (BM); Mt Gallego, *Hill* 8172 (BM). **Kolombangara Island.** Ridge west of Kolombangara River, *Hill* 10686 (BM). **Society Islands: Raiatea.** Tetooroa, 200 m, *Moore* L26 (Herb. Aptroot). **Fiji: Viti Levu.** Mt Tomanivi [Victoria], *Smith* 5205a (BM); Mt Victoria, *Selling* (S); *Lam* 6831 (L);

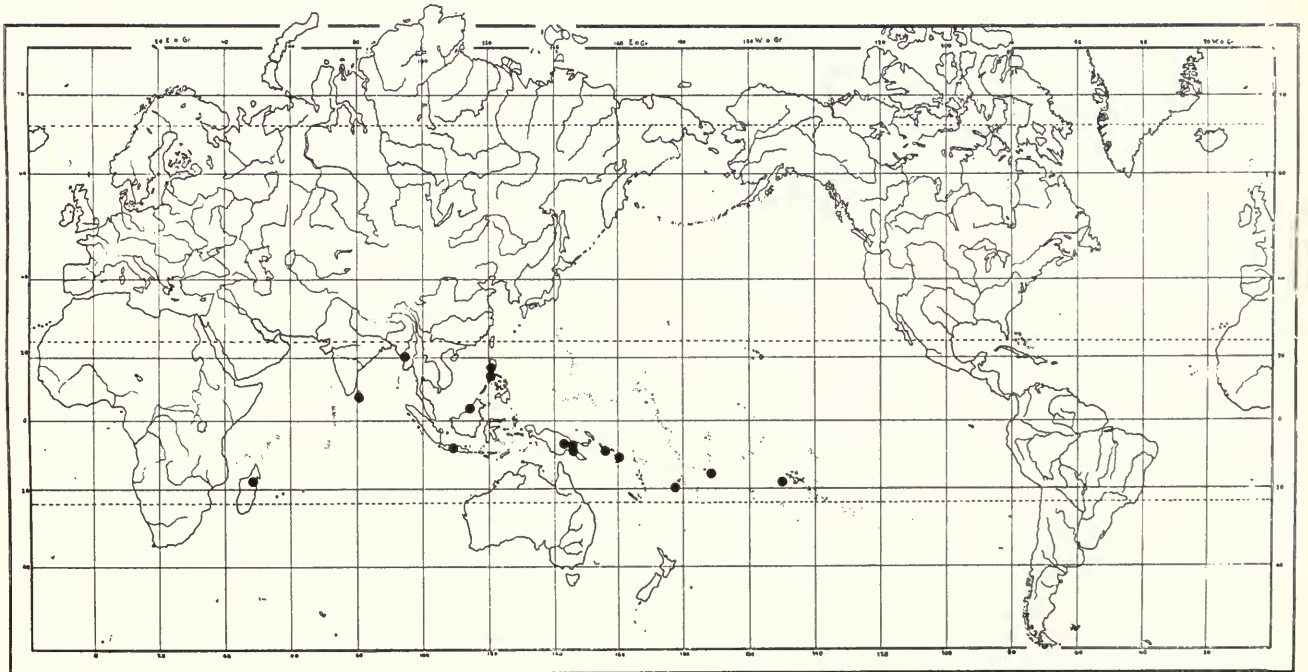


Fig. 4 Distribution of *Pseudocypbellaria beccarii* in the palaeotropics.

Mt Tomanivi [Victoria], *Smith* 5205a (US); Ra, ridge from Mt Namama toward Mt Tomanivi, *Smith* 5712 (BM). **Samoa:** **Upolu.** Mountains near Tiave, *Schultz-Motel* 4350 (B).

4. ***Pseudocyphellaria carpoloma*** (Delise) Vain. in *Hedwigia* **37**: 34 (1898). *Sticta carpoloma* Delise in *Mém. Soc. linn. Normandie* **2**: 159 pl. 19, right hand figure (1825). *Stictina carpoloma* (Delise) Nyl., *Syn. meth. lich.* **1**(2): 339 (1860). *Saccardoia carpoloma* (Delise) Trevis., *Lichenotheca veneta* exs. no. 75 (1869). *Cyanisticta carpoloma* (Delise) Gyeln. in *Reprum Spec. nov. Regni veg.* **29**: 2 (1931). Type: New Zealand, 'Sur les vieux arbres à la Nouvelle Zélande', Bay of Islands, 1824, ?R.P. Lesson (PC-LÉNORMAND-holotype). For additional synonymy see Galloway (1988: 80–85).

*Pseudocyphellaria carpoloma* is bright lettuce-green to olive-green when wet, pale olivaceous-greenish when dry; it is a characteristic dichotomously branching, white-medulla, green-photobiont species with yellow pseudocyphellae below, which is widespread in New Zealand (Galloway, 1988) but has not been previously correctly identified from tropical regions. It is discussed in detail in Galloway (1988: 80–85). Earlier tropical records of *P. carpoloma* such as Magnusson (1940, 1956), Magnusson & Zahlbruckner (1943), Szatala (1956) refer to specimens of *P. gilva*, a cyanobacterial species.

**CHEMISTRY.** Methyl evernate, tenuiorin, methyl gyrophorate, evernic acid (tr.), gyrophoric acid (tr.), hopane-7 $\beta$ , 22-diol, hopane-6 $\alpha$ , 7 $\beta$ , 22-triol, 7 $\beta$ -acetoxyhopane-6 $\alpha$ , 22-diol (tr.), 6 $\beta$ -acetoxyhopane-7 $\beta$ , 22-triol (tr.), norstictic (tr.), stictic, cryptostictic, and constictic acids, pulvinic dilactone, pulvinic acid and calycin.

**OBSERVATIONS.** *Pseudocyphellaria carpoloma* is characterized by dichotomously branching lobes with entire margins

and a distinctive, faveolate upper surface. It has a white medulla, a green photobiont and prominent yellow pseudocyphellae on the lower surface and projecting from the margins. Spores grey-brown, oval-ellipsoid, thickened 1-septate to 3-septate at maturity, (20–)22–25(–27)  $\times$  7–11  $\mu$ m.

**DISTRIBUTION AND ECOLOGY.** In the palaeotropics known so far only from Papua New Guinea and Norfolk Island from humid forest at 900 and 2500 m (Fig. 5). It is probably more widespread in the palaeotropics and is need of further collection.

**SPECIMENS EXAMINED.** **Papua New Guinea:** Madang. Finisterre Range. Teptep Village, *Aptroot* 31927 (Herb. Aptroot). **Norfolk Island:** Mt Bates, *Henderson* (E).

5. ***Pseudocyphellaria clathrata*** (De Not.) Malme in *Ark. Bot.* **26A**(14): 9 (1934). *Sticta clathrata* De Not., *Osserv. Sticta*: 19 (1851). *Crocodia clathrata* (De Not.) Trevis., *Lichenotheca veneta* exs. no. 75 (1869). Type: Brazil, in sylvis insulae S. Sebastiano, 1839, *Casaretto* (BM-lectotype (Galloway & Arvidsson, 1990: 119)). For additional synonymy see Galloway & Arvidsson (1990: 119).

*Pseudocyphellaria clathrata* is bright lettuce-green with a yellow-gold tinge when wet, grey-green often suffused reddish when dry or on storage; it is a characteristic rosette-forming to irregularly spreading, yellow-medulla species which is widespread in tropical regions (Galloway & Arvidsson, 1990; Galloway, 1993). Palaeotropical material examined agrees in all respects with the anatomical and morphological details given in Galloway & Arvidsson (1990: 121–126).

**CHEMISTRY.** Similar to that of *P. arvidsonii* and *P. aurata* (Galloway & Arvidsson, 1990) containing calycin, pulvinic

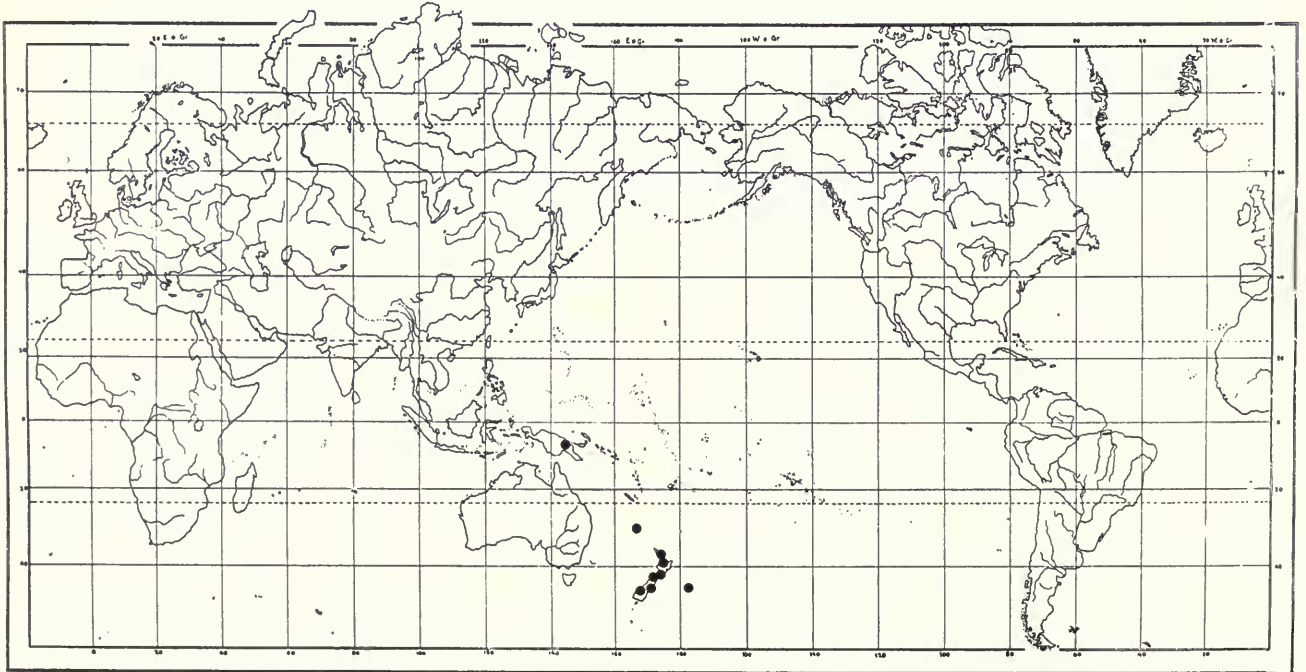


Fig. 5 Distribution of *Pseudocyphellaria carpoloma* in the palaeotropics.



lactone, pulvinic acid and a mixture of unidentified fernene triterpenoids.

**OBSERVATIONS.** *Pseudocyphellaria clathrata* is a widely distributed pantropical species having rather large, broadly rounded to subdichotomously or irregularly branching lobes with entire, non-sorediate, non-phyllidiate margins and is characterized by a yellow medulla, a green photobiont, yellow pseudocyphellae on the lower surface, a glabrous to partly pubescent or tomentose upper surface which is  $\pm$  distinctly punctate-impressed, and distinctly pedicellate marginal to submarginal apothecia. Apothecia distinctly pedicellate, areolate-scabrid to white-tomentose, concolorous with thallus. Spores fusiform-ellipsoid, pointed at one or both ends, 3-septate at maturity, pale red-brown,  $(15.5\text{--})18\text{--}20.5\text{--}(22.5) \times 3.5\text{--}4.5 \mu\text{m}$ .

**DISTRIBUTION AND ECOLOGY.** Widespread in tropical regions of the world (Swinscow & Krog, 1988; Galloway & Arvidsson, 1990; Galloway, 1993) and recently collected in northern India by Dr K.P. Singh (Fig. 6). In humid montane forest, in canopy branches and main branches of shrubs and trees, rarely on rocks, 400–1600 m.

**SPECIMENS EXAMINED.** **Africa.** **Uganda:** Kabale, *Burnet* 230 (BM); West Mingo, *Lye* L 196 (BM). **Zimbabwe:** sine loco, *Sim* (BM). **Tanzania:** Ngorongoro Crater, *Pocs & Chuwa* 89027/Z (BM); Usumbara Mountains, Amani, *Moberg* 1491b (UPS). **Kenya:** Ngong Hills, *Meyink* (BM); Mt Kenya, *Swinscow* (BM); Kakamega District, *Santesson* 21764 (UPS); Kajiado District, Ngong Hills, *Moberg* 1413 (UPS). **South Africa:** **Cape Province.** Table Mountain, *Sipman* 20.186 (B); Disa Gorge, Table Mt, *Pillans* (BM). **Angola:** Golungo Alto, *Welwitsch* (BM). **Madagascar:** sine loco, *Sykora*, 1894 (WU); Imerina, Andrangoloaka, 1880, *Hidebrandt* 2156 (WU); Imerina, *Wills* (BM). **Réunion:** sine loco, *Lepervanche Mezières* (M); southern slopes of Piton des Niegés, near

Cilaos, *Arvidsson & Nilsson* 2538 (GB); Cirque de Cilaos, *de Sloover* 17/472 (LG). **Java:** Mt Ardjuno, *Groenhart* 9769 (L). **Tjibodas,** *Arvidsson & Nilsson* 2494 (GB). **Philippines:** **Luzon.** Benguet, Bangio, *Elmer* 8991 (BM). **Papua New Guinea:** **Eastern Highlands.** Goroka, Lapegu, *Streimann* 18272, 18289 (CBG). **Morobe.** Mt Kaindi, *Kashiwadani* 10516 (TNS); Kauli Lake, *Streimann* 34079, 34092 (CBG); Yinimba, *Streimann* 19177 (CBG). **Western Highlands.** Baiyer River Sanctuary, *Streimann* 21105 (CBG); Kagamunga, *Streimann* 21301 (CBG); Minj, *Streimann* 21504 (CBG). **New Caledonia:** Ile des Pins. Tribu de Gadji, *Hill* 12099 (BM). **Norfolk Island:** sine loco, *F. Bauer* (W).

6. *Pseudocyphellaria crocata* (L.) Vain. in *Hedwigia* 37: 34 (1898). *Lichen crocatus* L., *Mant. pl.*: 310 (1771). Type: India, without specific location, *König* (LINN 1273.137-holotype). For additional synonymy see Galloway (1988: 113) and Galloway & Arvidsson (1990: 126).

*Sticta xanthosticta* Pers. in *Gaudich., Voy. Uranie*: 201 (1827). Type: [Hawaii] in insulis Sandwicensibus, *Gaudichaud* (L 910.187.685-lectotype, selected here).

*Sticta crocata* f. *sandwicensis* Zahlbr. in *Rech., Denkschr. Akad. Wiss. Wien* 88: 29 (1911). *Cyanisticta sandwicensis* (Zahlbr.) Gyeln. in *Reprim Spec. nov. Regni veg.* 29: 6 (1931). Type: Hawaii. Vulkan Kilauea, auf arten von *Metrosideros*, April 1905, *N. Rechinger* 2544 (W-lectotype, selected here).

*Pseudocyphellaria hawaiiensis* H. Magn. in *Acta Horti gothoburg.* 14: 21 (1940). *Cyanisticta hawaiiensis* (H. Magn.) Räsänen in *Suomal. elain-ja kasvit. Seur. van. kasvit. Julk.* 20(3): 17 (1944). Type: Hawaii. Molokai, between Upper Mountain Camp and Pepeopae, 9 July 1938, *O. Selling* 5842 (UPS-isotype).

*Cyanisticta hawaiiensis* var. *scrobiculata* Räsänen in *Suomal. elain-ja kasvit. Seur. van. kasvit. Julk.* 20(3): 17 (1944).

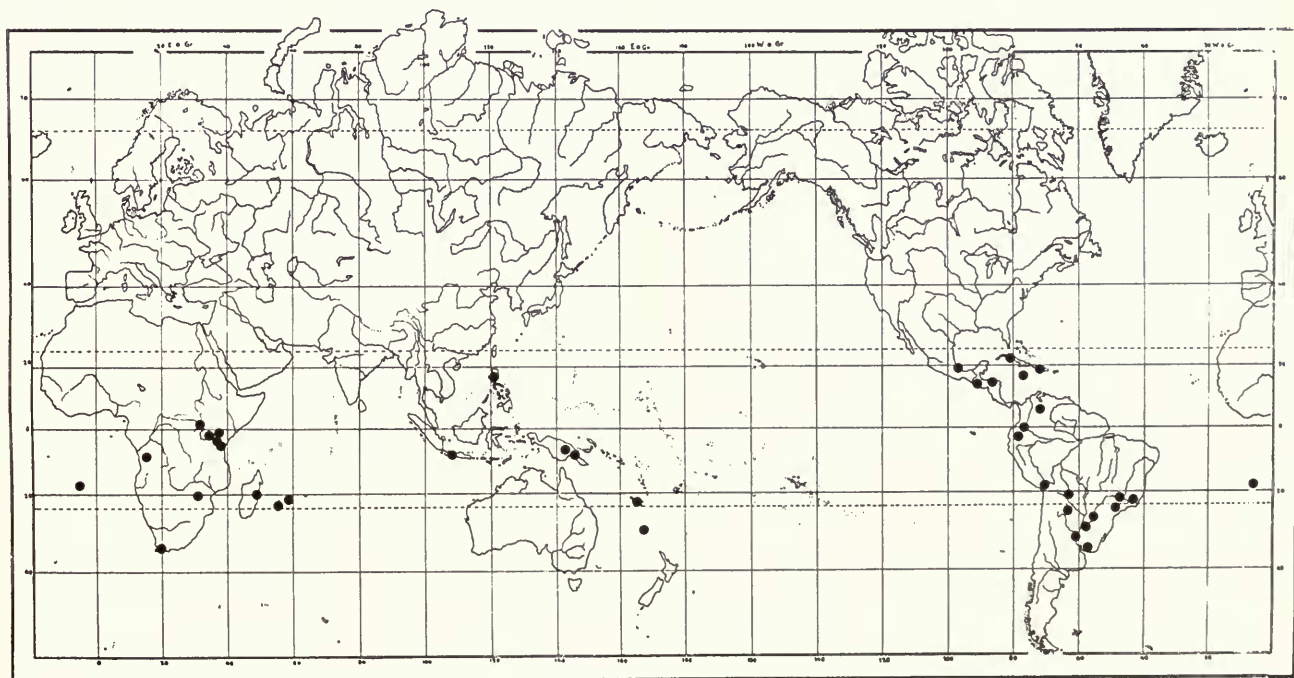


Fig. 6 Distribution of *Pseudocyphellaria clathrata* in the palaeotropics.

Type: Tahiti. Sine loco, *Vieillard* (H-not seen).

*Cyanisticta hawaiiensis* var. *xanthocardia* Räsänen in *Suomal. elain-ja kasvit. Seur. van. kasvit. Julk.* 20(3): 17 (1944).

Type: Tahiti. Sine loco, *Vieillard* (H-not seen).

*Pseudocyphellaria crocata* is dark slate-blue to blue-black or glaucous brownish often suffused red-brown when wet, pale olivaceous grey or blue grey to red-brown when dry; it is widespread in both tropical and temperate regions of the world and shows both throughout and within its range a considerable plasticity of form which has led to an extensive synonymy. Palaeotropical material is also very variable but within the range of anatomy and morphology recorded by Galloway (1988: 115–118). Hawaiian material recorded as *P. hawaiiensis* (Magnusson, 1940; Magnusson & Zahlbruckner, 1943) tends to have narrower,  $\pm$  dichotomously branching lobes with the soralia often restricted to small, scattered, marginal clumps, but in a range of recently collected material (Prof. C.W. Smith, pers. comm.) a complete sequence from broad-lobed, laminally and marginally sorediate forms to narrow-lobed,  $\pm$  dichotomously branching, sparsely marginally sorediate forms was observed, all of which fall within the species range of variation.

**CHEMISTRY.** Tenuiorin, methyl gyrophorate, gyrophoric acid (tr.), hopane-6 $\alpha$ , 7 $\beta$ , 22-triol (major), 6 $\alpha$ -acetoxyhopane-7 $\beta$ , 22-diol (tr.), 7 $\beta$ -acetoxyhopane-6 $\alpha$ , 22-diol (tr.), hopane-7 $\beta$ , 22-diol (tr.),  $\pm$  physciosporin (tr.) norstictic (tr.), stictic, cryptostictic, constictic and  $\pm$  salazinic acids, pulvinic acid and pulvinic dilactone (Elix et al., 1992).

**OBSERVATIONS.** *Pseudocyphellaria crocata* is characterized by a white medulla; a cyanobacterial photobiont; yellow laminal and marginal soralia on the faveolate to plane upper surface, and yellow pseudocyphellae on the lower surface. Apothecia are rather variable in occurrence varying from moderately common to rare or absent. Spores are broadly

ellipsoid, smoky olive-brown to dark brown, thickened 1-septate to irregularly 3-septate, straight or slightly curved, 22.5–27(–29.5)  $\times$  7–9  $\mu$ m. It has a characteristic chemistry including hopane-6 $\alpha$ , 7 $\beta$ , 22-triol, stictic acid metabolites, tenuiorin and methyl gyrophorate and yellow pigments. It is distinguished mainly by its soredia from other members of the *P. crocata*-group; *P. gilva* has neither soredia nor isidia or phyllidia; *P. crocatoides* has characteristic marginal lobules but no soredia or true isidia; *P. neglecta* has marginal and laminal phyllidia which may erode and become pseudosorediate; while *P. desfontainii* has terete to subsquamiform isidia which never become sorediate.

**DISTRIBUTION AND ECOLOGY.** Widely distributed in the palaeotropics and neotropics and in cool temperate zones of both Northern and Southern Hemispheres (Fig. 7). One of the most widely distributed species in the genus. It occurs in a wide variety of habitats from sea level to 4200 m (in Papua New Guinea) as an epiphyte of trees, shrubs, on rotting logs and on the forest floor, on both shaded and sunny rocks, and on soil in alpine grasslands. In the palaeotropics it occurs most commonly in humid, shaded woodlands, montane forest, cloudforest and alpine grasslands.

**SPECIMENS EXAMINED.** **Africa. Tanzania:** Kiliminjaro, *Bigger* 1966 (BM). **Kenya:** Mt Marsabit, *Lye* L660 (BM); Aberdare Mts, *Swinscow* (BM). **Uganda:** Usumbara Mts, *Holst* 2665 (BM); Sasa River above Bulambuli, *Lye* L 501 (BM). **South Africa: Cape of Good Hope.** Table Mountain, *Wedermann & Oberdieck* 48 (B); ?Tafelberg, *Wilms* (B). **Transvaal.** Houbosdorp, *Sipman* 19.786 (B); Kowyns Pass near Graskop, *Sipman* 19.936 (B); Long Tom Pass, *Sipman* 20.093 (B). **Madagascar:** sine loco, *Baron* (BM). **Réunion:** Cirque de Cilaos, auf der Strasse zwischen Cilaos und Ilet a Cordes auf den Col du Taibit, *K. & A. Kalb* 26567 (Herb. Kalb); Piton de la Grande Montée, près des sources Reihlac, *de Sloover*

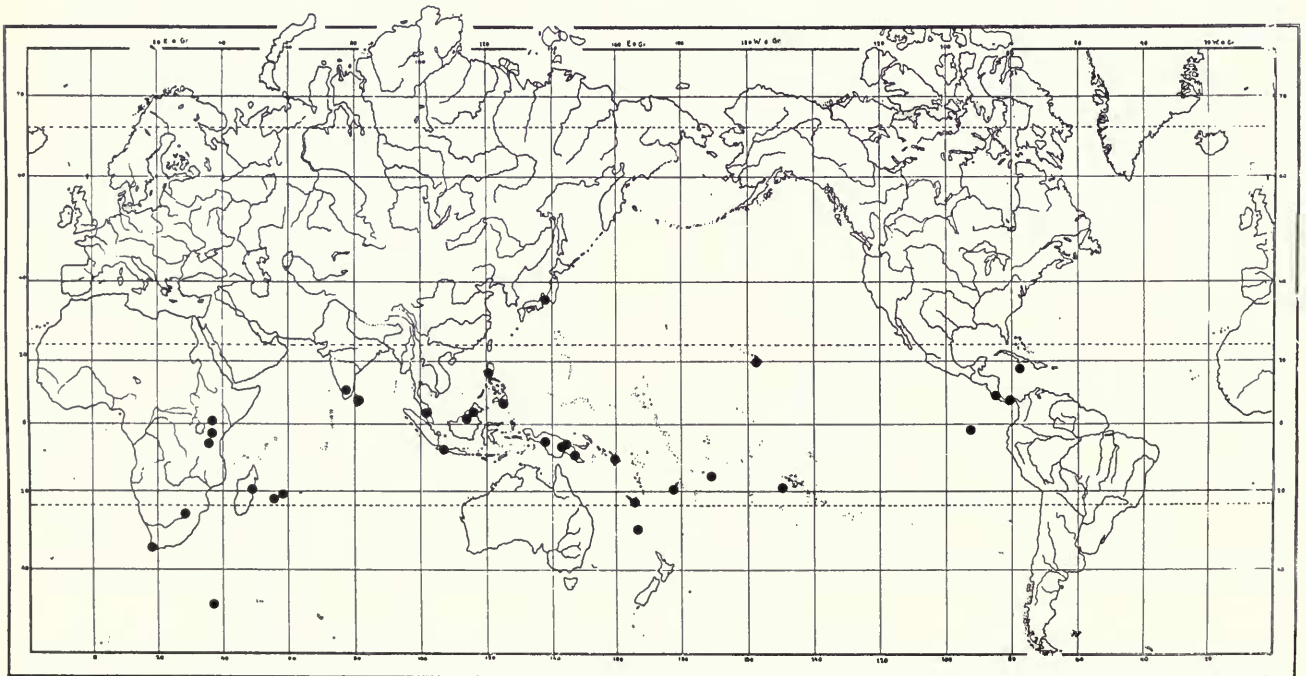


Fig. 7 Distribution of *Pseudocyphellaria crocata* in the palaeotropics.

17.257 (LG); SW du Piton Mare-a-Boue, *de Sloover* 17.299 (LG); Cirque de Cilaos, *de Sloover* 17.538, 17.577, 127.927 (LG). **Mauritius:** Pouce Mt, *Ayres* (BM); Curepipe, sine coll. (BM). **Sri Lanka:** Central Province, *Thwaites* C.L. 24 (BM). **Malaysia:** **Pahang.** Fraser's Hill, *Burkill* 2099 (L); Fraser's Hill, *Galloway* (KEP); Cameron Highlands, Tanak Tara, *Degelius* As-567 (UPS). **Sabah.** Mt Kinabalu, *Sipman & Tan* 31105, 31079, 31024 (B). **Sarawak.** Gunung Mulu National Park, *Argent & Coppins* 5116 (BM). **Indonesia.** **Sulawesi:** sine loco, Herb. Lugd. Batav. (L). **Java:** Tjibodas, *Koernich* 6a (Herb. Aptroot); *Sipman & Zainal* 30094 (B); Kawi Mountains. Mt Panderman, *Groenhart* 1934 (Herb. Aptroot); sine loco, *Jelinek* (B); Idgen Plateau, Kebun Djampit, *Pos* 7379 (B); sine loco, *Junghuhn* (L); Mt Pangerango, *Schiffner* 3288 (W); Cibodas Botanical Garden, *Arvidsson & Nilsson* 2488 (GB). **Philippines:** **Luzon.** Benguet, Mt Santo Tomas, *Aptroot* 20447, 20448, 20452, 20453 (Herb. Aptroot); Mt Pulog, *Merrill* 6458 (BM). **Mindanao.** Mt Apo, *Copeland* 1093 (BM). **West Irian:** Eipomek-Tal, *Hiepkö & Schultze-Motel* 2019, 2277 (B); Carstensz Mts, *Hope* (COLO). **Papua New Guinea:** **Morobe.** Saruwaged, *Sipman* 24336, 24386, 24429, 24462 (B); Kaisinik, *Kashiwadani* 10448, 10686, 10745, 10760 (TNS); Mt Missin, *Kashiwadani* 10428 (TNS); Rawlinson Range, *Strong Clemens* 12444 (COLO); Araul Logging Area, *Streimann* 13593, 13620 (CBG); Koke Village, *Streimann & Tamba* 11658, 11752 (CBG); Honzeukngon village, *Aptroot* 17826, 17928, 17930, 18019 (Herb. Aptroot); Ekuti Divide, *Streimann* 20164, 20355, 20362 (CBG); Herzog Mountains, *Streimann & Umba* 11113 (CBG); Spreader Divide, *Streimann & Tamba* 11895, 12073, 12208, 12211 (CBG); Slata Creek, *Streimann* 14045 (CBG); Herzog Mountains, *Streimann & Umba* 11134 (CBG); Yinimba, *Streimann* 19712 (CBG); head of Black Cat Creek, *Streimann* 25644 (CBG); Gumi Divide, *Streimann* 22764, 25729 (CBG); **Madang.** Finisterre Range, Teptep Village, *Aptroot* 31931, 32285, 32289, 32290, 32291 (Herb. Aptroot). **Eastern Highlands.** Chimbu. Mt Wilhelm, *Borgmann* 732b, 919 (B); *Aptroot* 18282, 18396, 18528, 18655, 32828, 32834 (Herb. Aptroot); *Kashiwadani* 10880, 10921, 10967, 10998, 11011, 11051, 11062, 11125, 11144, 11312, 11329, 11354 (TNS); *McVean* 66123, 66234, 66254 (CBG); Pindaunde Valley, *Aptroot* 31354, 32742, 33112 (Herb. Aptroot); Toromambuno, *Walker* 8315 (CBG); Lake Piunde, *Sipman* 21985, 22132 (B); Goroka. Mt Zapaliga, 2650 m, *Iserentant* 9546 (Herb. Aptroot); Mt Gahavisuki Provincial Park, *Sipman* 22185 (B); near Mopei Village, *Streimann* 18844 (CBG); Daulo Pass, *Streimann* 18021, 18029, 18077 (CBG). **Western Highlands.** Yobobos, *Hoogland & Schodde* 7639 (B); Kubor Range. Nona River, *Vink* 16473 (Herb. Aptroot); Milep Area, *Vinas* 7644 (CBG); Jimi-Waghi Divide, *Streimann* 22317 (CBG); Kum Magnei Mtn, *Streimann* 20646-7 (CBG); Nebilyer River, *Streimann* 20597 (CBG); Kagamuga, *Streimann* 20429, 21751 (CBG); **Central.** Mt Albert-Edward, *Kashiwadani* 11501, 11758, 11936, 12000 (TNS); 2 km N. of the Waiotape Airstrip, *Kashiwadani* 11657, 12045, 12242 (TNS); Ehu Creek, *Streimann & Naoni* 16615 (CBG); Mt Victoria area, *V. Royen* 10957 (CBG). **Southern Highlands.** Mt Giluwe, *Streimann* 24219 (CBG); Onim Forestry Station, *Streimann* 23592, 24562, 24614, 24631, 24635, 24638, 24640 (CBG); **Enga.** Mape Creek, *Streimann* 22112 (CBG); **Gulf.** Hepataewa, *Streimann* 33845 (CBG). **Solomon Islands:** **Guadalcanal Island.** Mt Gallego, *Hill* 8381 (BM); Mt Popomansiu, *Hill* 9379, 9458, 9625, 9725 (BM). **New Caledonia:** **Noumea.** Mt Koghi, *Hill* 11509 (BM). **Sarramea.** Col

d'Amieu, *Hill* 11884, 11958 (BM). **Norfolk Island:** Selwyn Pine Road, *Streimann* 34663, 34661 (CBG); Mt Pitt, *Streimann* 34817 (CBG); track from Red Road to Mt Bates, *Streimann* 34444 (CBG). **Fiji:** **Viti Levu.** Nadarivatu. District Commissioners House, *Degener* 31814ae.u (B); Nandarivatu, *Green* (BM); Nadala, *Degener* 31807 (B); Mt Nairosa, *Smith* 4100, 4420 (BM). **Samoa:** **Upolu.** *Rechinger* (W); Tutuila, *Reinecke* 62a (BM). **Tahiti:** Fautaua Valley, *Seitchell & Parks* 5442 (BM). **Hawaiian Islands:** **Hawaii.** Mauna Loa, *Rock* [Zahlbruckner: Lich. Rar. Exsic. 171] (BM, B, W); Kipuka Ki, *Degener* 31426 (B); *Weber & Bujakiewicz* (B); Waimea, [ad truncos muscosos in paludosis] *Szatala* [Lichenes Sandwichenses] (B); Glenwood, *Faurie* 938 (BM); Saddle Road, Kipuka, *Smith* 4953 (Herb. Smith) **Kauai.** Sine loco, [on trees] *Heller* (B); Hanapepe River, *Heller* 2630a (BM); Mt Gay summer house, *Faurie* 297 (BM); E. of Kalalau Lookout, *Wedin* 3722 (UPS). **Maui.** Haleakala. Puu Uianiau, 7000 ft, *Degener* 22242 (B); Haleakala National Park, Kalua awa, *Medieros* (Herb. Smith); **Oahu.** Mt Kaala summit, *Degener* 30064 (B); Puu Hapapa near Kolekole Pass, *Doty* (B); Waianae Range, Kaala Natural Area Reserve, *Wedin* 3698 (UPS); Honouliuli Forest Reserve, *Smith* 4125 (Herb. Smith). **Galapagos Islands:** **Isla Sant Cruz.** Academy Bay, *Weber* (COLO); *Horneman* 4/64 (COLO).

7. *Pseudocypbellaria crocatoides* D.J. Galloway in *Graphis Scr.* 5: 8 (1993). Type: Fiji. Taveuni, Mt Utugatau, near summit, tree trunks in rainforest, c. 1140 m, 22 April 1970, *G. Degelius* P-236 (UPS-holotype; BM-isotype). Fig. 8.

*Thallus* in irregular rosettes or loosely spreading, 4-7(-9) cm diam., loosely attached centrally, margins free and  $\pm$  ascending. *Lobes* narrow, 2-5 mm wide, rarely to 10 mm wide, irregularly to complexly branched,  $\pm$  imbricate centrally,  $\pm$  discrete at margins. *Margins* sinuous or ragged, dentate-incised to  $\pm$  richly phyllidiate, slightly thickened below and occasionally also ridged above, occasionally with protruding yellow pseudocypbellae. *Upper surface* dark slate-blue to blue-black when wet, pale glaucous greyish when dry, undulate, matt, smooth, wrinkled to subfaveolate especially at lobe apices, very fragile, friable when dry, pliable when wet. *Phyllidia* common and conspicuous, mainly marginal, very variable,  $\pm$  dorsiventral, simple to coralloid-branched, 0.2-1 mm tall (to 3 mm long), fringing lobes with clustered, finger-like proliferations. *Maculae* occasional to frequent, white or pale yellowish,  $\pm$  distinctly reticulate, following shallow ridges and in faveolae ( $\times$  10 lens). *Isidia*, pseudocypbellae and soredia absent. *Medulla* white. *Photobiont* cyanobacterial. *Lower surface* pale yellowish white to buff-brown at margins darkening centrally, tomentum pale whitish to grey or buff, to brown-black centrally, rather sparse at margins, thick and entangled centrally. Pseudocypbellae yellow, low-conical, scattered,  $\pm$  rounded, 0.1 mm diam. or less, margins only slightly raised, decorticate area flat to convex.

*Pycnidia* rather sparse, solitary, scattered, at margins and along laminal ridges, ostiole red-brown, punctate-depressed, 0.1 mm diam. or less.

*Apothecia* very rare, solitary, marginal, sessile, constricted at base, rounded, cupuliform, 1-1.5 mm diam., exciple pale buff or brownish,  $\pm$  translucent when wet, coarsely corrugate-scabrid, with a conspicuous, irregularly dentate margin, disc red-brown, slightly roughened and with a thin

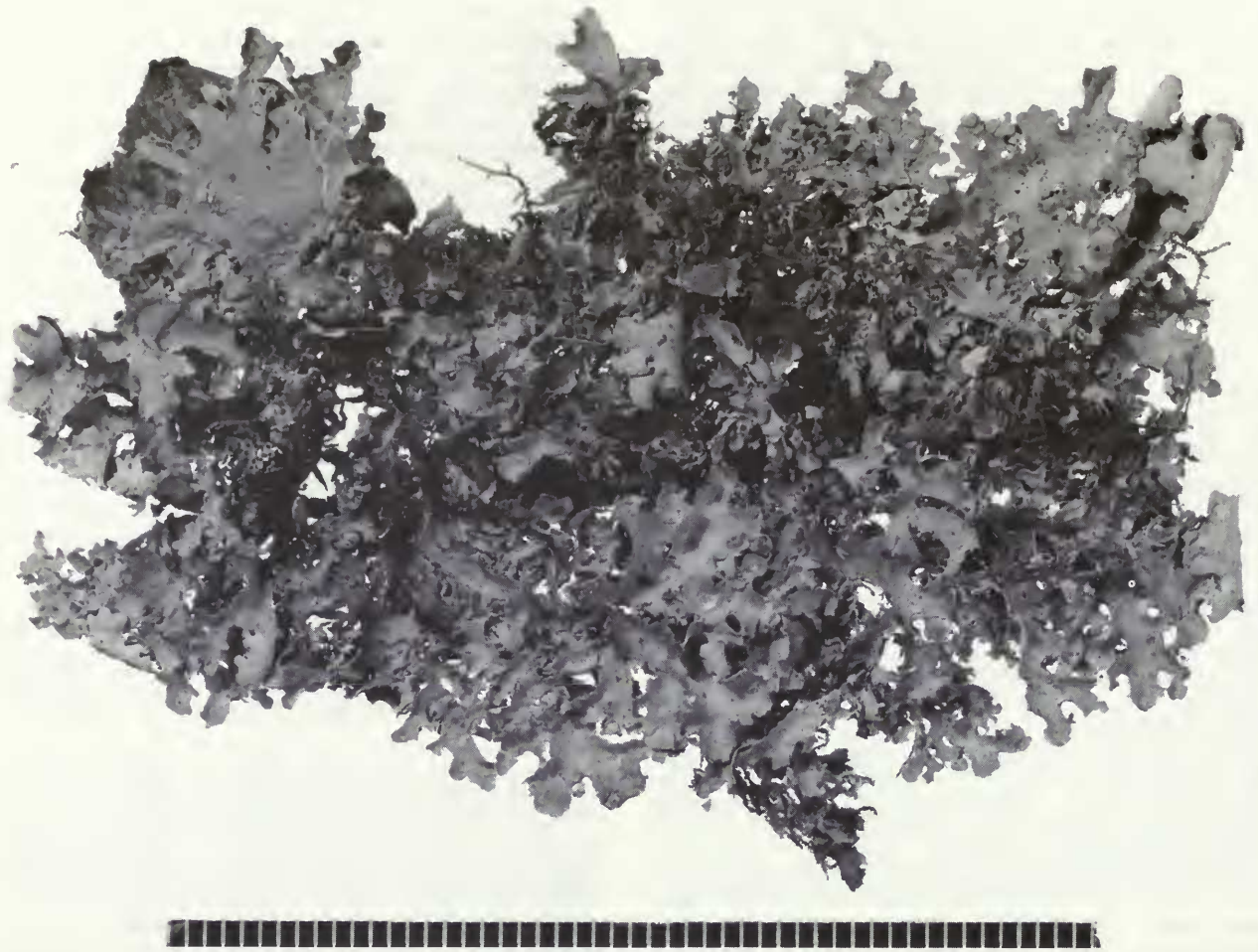


Fig. 8 *Pseudocyphellaria crocatoides*. Isotype (BM). Scale in mm.

white pruina. *Epithecium* 10–14  $\mu\text{m}$  thick, red-brown. *Hymenium* colourless to pale straw, 70–80  $\mu\text{m}$  tall. *Ascospores* not seen.

**CHEMISTRY.** Pulvinic acid, pulvinic dilactone, 6 $\alpha$ -acetoxyhopane-7 $\beta$ -22-diol (tr.), 7 $\beta$ -acetoxyhopane-6 $\alpha$ , 2-diol (tr.), hopane-7 $\beta$ , 22-diol (tr.), hopane-6 $\alpha$ , 7 $\beta$ , 22-triol (major), tenuiorin, methyl gyrophorate, gyrophoric acid (tr.),  $\pm$  physciosporin (tr.), norstictic (tr.), stictic, cryptostictic, constictic acids.

**OBSERVATIONS.** *P. crocatoides* is a characteristic species of the *P. crocata* group and has a white medulla, a cyanobacterial photobiont, yellow pseudocyphellae on the lower surface and a chemistry containing stictic acid metabolites, hopane-6 $\alpha$ , 7 $\beta$ , 22-triol as the dominant triterpenoid, and the pigments calycin, pulvinic acid and pulvinic dilactone (Galloway & Kemp, 1993). It is distinguished by the distinctive marginal (rarely laminal) lobulate proliferations, and a smooth upper surface without isidia or soredia, characters which separate it from *P. crocata* which is yellow-sorediate; from *P. dozyana* which is white-sorediate; from *P. desfontainii* which has terete to squamiform isidia; from *P. neglecta* which has

phyllidia which erode to become pseudosorediate; and from *P. gilva* which has entire margins and is without soredia, isidia, phyllidia or lobulate proliferations.

**DISTRIBUTION AND ECOLOGY.** Known from Fiji, Papua New Guinea (see below) and also eastern Australia (Fig. 9). Still very poorly collected. Palaeotropical collections so far seen are from humid, shaded, montane rainforest, 840–3000 m.

**SPECIMENS EXAMINED.** **Fiji:** Taveuni, Mt Utuigatau, *Degelius* P-243 (UPS); Nandarivatu, *Green* (BM). **Papua New Guinea:** **Morobe.** Mt Kaindi, *Streimann* 17622 (CBG). **Eastern Highlands.** Mt Wilhelm, *Kashiwadani* 10866 (TNS).

8. ***Pseudocyphellaria desfontainii*** (Delise) Vain., *Résult. Voy. Belgica, Lich.*: 29 (1903). *Sticta desfontainii* Delise in *Mém. Soc. linn. Normandie* 2: 60 pl. 4, fig. 12 (1825). *Stictina carpoloma* f. *desfontainii* (Delise) Nyl. in *Hue, Nouv. Archs Mus. Hist. nat. Paris* III, 2: 297 (1890). *Sticta carpoloma* f. *desfontainii* (Delise) Zahlbr., *Cat. lich. univ.* 3: 374 (1925). *Cyanisticta desfontainii* (Delise) Räsänen in *Suomal. elain-ja kasvit. Seur. van. kasvit. Julk.* 2(1): 42 (1932), non C.W. Dodge (*Beih. nov. Hedwigia* 12: 173

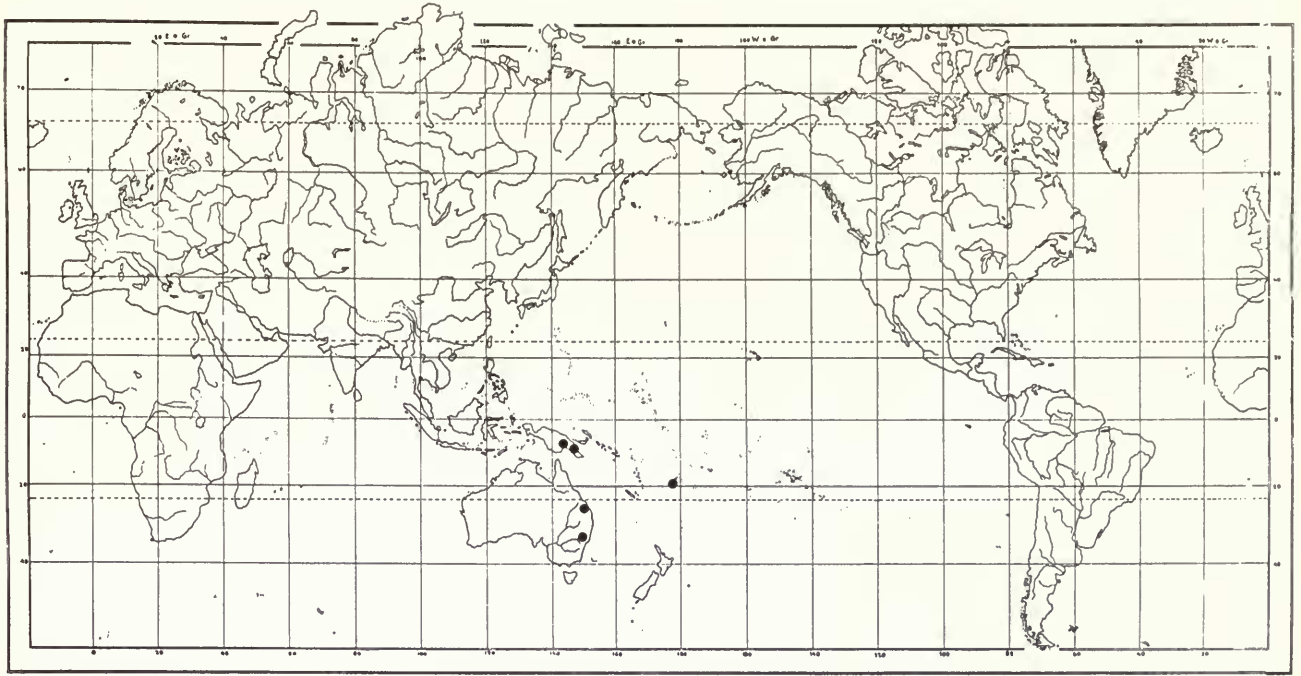


Fig. 9 Distribution of *Pseudocyphellaria crocatoides*.

(1964)). Type: Ile de Bourbon, *Bory de St-Vincent* (PC-THURET-lectotype (Galloway & James, 1986: 434)).

Fig. 10.

*Cyanisticta crocata* var. *tingaensis* Sbarbaro in *Arch. Bot.* **15**: 102 (1939). Type: Rarotonga, June 1929, *H.E. Parks* (Not seen).

*Pseudocyphellaria ceylonensis* H. Magn. in *Acta Horti gothoburg.* **14**: 23 (1940). Type: Ceylon [Sri Lanka], Central Province, *G.H.K. Thwaites* 26 (UPS-isotype).

*Cyanisticta mougeotiana* ssp. *dentata* Räsänen in *Suomal. elain-ja kasvit. Seur. van. Julk.* **20**(3): 16 (1944). Type: New Caledonia, ad corticem arboris, 1863, *E. Vieillard* (H-not seen).

*Thallus* rosette-forming to irregularly spreading, 4–9(–11) cm diam., closely attached centrally, margins  $\pm$  free. *Lobes* 2–8(–15) mm wide, (0.5)1–3(–6) cm long, subdichotomously branching to complex-imbricate, discrete, contiguous or sub-imbricate at margins, complex-imbricate centrally. *Margins* entire in parts (especially at lobe apices) to indented, ragged, incised, crenulate, slightly thickened and ridged below, sparsely to densely isidiate. *Upper surface* dark glaucous blue to blue-black, suffused red-brown towards apices when wet, glaucous grey or pale bluish to red-brown when dry, undulate, shallowly pitted or punctate-impressed to deeply faveolate, ridges sharply defined to smoothly rounded, matt to slightly shining in parts, flabby when wet, brittle and rather fragile when dry, isidia easily broken off leaving yellow scars, without soredia, phyllidia or pseudocyphellae. *Maculae* common, minute, white or yellowish, effigurate to  $\pm$  reticulate, best seen when wet (use  $\times 10$  lens). *Isidia* sparsely to densely developed, often crowded at margins also on interconnecting ridges or in faveolae, solitary to crowded in groups, terete, simple, rarely squamiform or coralloid, 0.5–1.5 mm tall and 0.1–0.2 mm diam., concolorous with upper surface, eroding

at apices and appearing pseudosorediate, breaking off and leaving yellow scars resembling pseudocyphellae. *Medulla* white, often suffused yellow in upper parts in some collections. *Photobiont* cyanobacterial. *Lower surface* pale yellow-white or buff at margins darkening to red-brown or brown-black centrally, wrinkled-undulate, tomentose from margins to centre or with a narrow, glabrous, marginal zone, tomentum thick and woolly, white to dark brown or  $\pm$  blackened. *Pseudocyphellae* yellow, common, scattered, rounded, minute, 0.2 mm diam. or less, rarely 0.5 mm diam., conical-verruciform, decorticate area flat to convex.

*Pycnidia* laminal, scattered, inconspicuous, slightly swollen, ostiole minute, red-brown to black, 0.1 mm diam. or less.

*Apothecia* sparse (often absent) to  $\pm$  frequent, marginal and laminal 0.5–3 mm diam., sessile, constricted at base to subpedicellate, shallowly to deeply cupuliform,  $\pm$  deeply concave to undulate and  $\pm$  plane at maturity, exciple prominent, persistent, pale whitish pink,  $\pm$  translucent when wet, brownish or red-brown when dry, coarsely corrugate-scarbid, obscuring disc at first, rupturing and leaving an irregular dentate margin, disc red-brown to  $\pm$  blackened, grey-white pruinose. *Epithecium* red-brown, 8–14  $\mu$ m thick. *Hymenium* colourless to pale straw to pale or dark red-brown, 80–100  $\mu$ m tall. *Ascospores* red-brown, ellipsoid, apices pointed, 1-septate, 23–28(–30.5)  $\times$  (5.5)–6.5–8.5(–11)  $\mu$ m.

**CHEMISTRY.** Tenuioirin, methyl gyrophorate, gyrophoric acid (tr.), hopane-6 $\alpha$ , 7 $\beta$ , 22-triol, 7 $\beta$ -acetoxyhopane-6 $\alpha$ , 22-triol (tr.), 6 $\alpha$ -acetoxyhopane-7 $\beta$ , 22-diol (tr.), stictic, cryptostictic, and constictic acids, pulvinic acid, pulvinic dilactone and calycin.

**OBSERVATIONS.** *Pseudocyphellaria desfontainii* is characterized by a white medulla; a cyanobacterial photobiont; terete,  $\pm$  fingerlike isidia on the upper surface; yellow

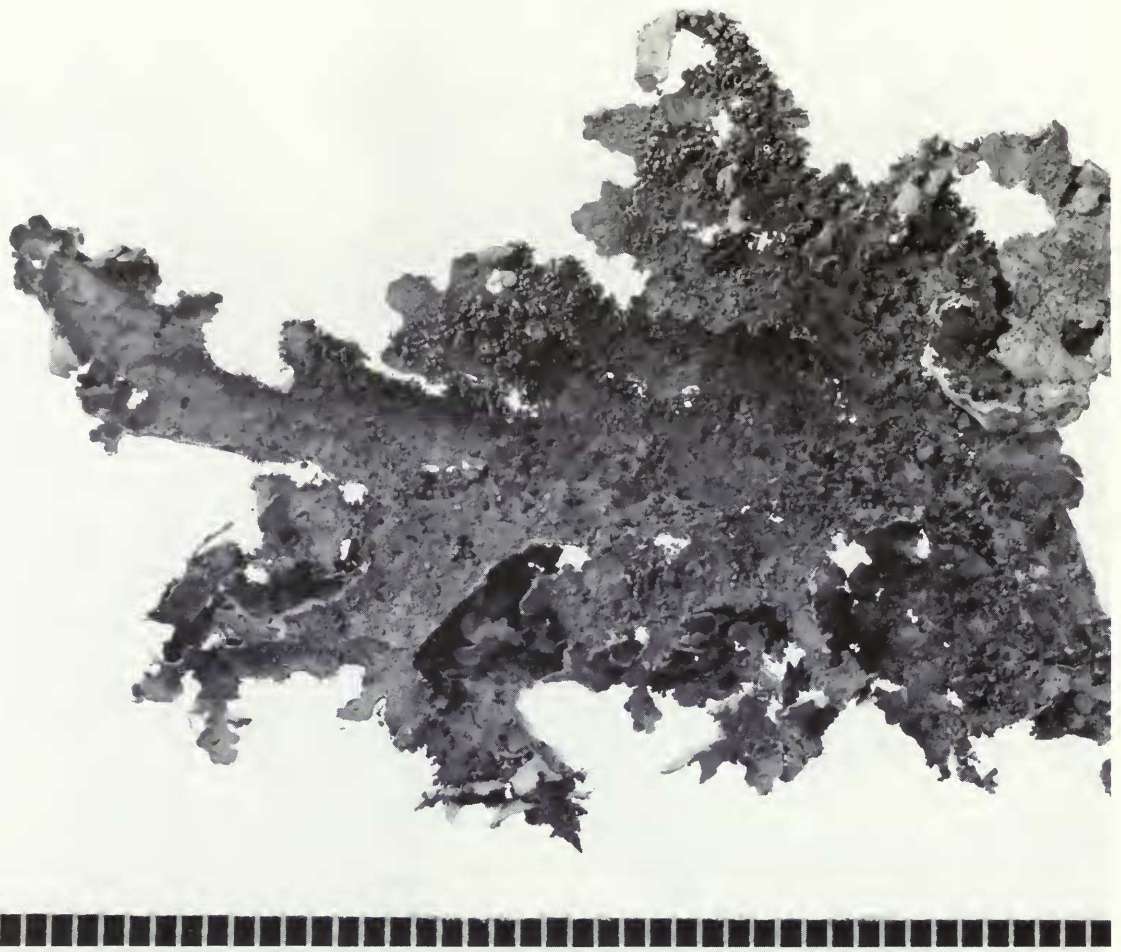


Fig. 10 *Pseudocyphellaria desfontainii*. T.G.A. Green s.n. (BM) Scale in mm.

pseudocyphellae on the lower surface; and a chemistry containing yellow pigments, a dominant hopane-triol and metabolites of the stictic acid aggregate. Its characteristic isidia distinguish it from other members of the *P. crocata* group (see above under *P. crocata* and *P. crocatoides*).

**DISTRIBUTION AND ECOLOGY.** A strictly palaeotropical taxon (Fig. 11), occurring from Africa to the south-western Pacific eastwards as far as the Marquesas, but not recorded from Hawaii, or the Galapagos Islands (Weber, 1986). On living and dead trees, on rotting logs and on shrubs in montane rainforest, 800–3650 m.

**SPECIMENS EXAMINED.** **Africa. Tanzania:** Usambara. Amani, *Brunnthal* (W). **Madagascar:** sine coll. (L-ex Herb Paris); Ambohitombo Forest, *Forsyth Major* 469, 554, 576, 583, 587 (BM). **Mauritius:** sine loco, *McGregor* (BM); Les Mares, *Ouhamed* 8 (BM). **Réunion:** Cirque de Salazie, *K. & A. Kalb* 26562 (Herb. Kalb); zwischen le Brûlé (S von St-Denis) und Plaine des Chicots, *K. & A. Kalb* 26563 (Herb. Kalb); southern slopes of Piton des Neiges, near Cilaos, *Arvidsson & Nilsson* 2539 (GB). **Sri Lanka:** above Pattipola, Horton Plains, *van Steenis* 19924d (L); Mount Pedro, *Blatter* 56 (W);

Nuwara Eliya. Horton Plains, Farr Inn, *Moberg* 2585, 2598 (UPS); Hakgala Botanical Garden, *Lundqvist* 9003 (UPS); Hakgala Botanical Garden, *Degelius* As-411 (UPS); Nuwara Eliya, *Degelius* As-440 (UPS). **Malaysia: Sabah.** Kota Belud, Mt Kinabalu, *Sipman & Tan* 31104 (B). **Pahang.** Fraser's Hill, *Burkill* 2073b, 2796 (L); *Dransfield* 515 (BM); *Degelius* As-611, As-620 (UPS); *Galloway* (KEP); Cameron Highlands, Tanak Rata, *Degelius* As-568, As-576 (UPS). **Indonesia. Java:** Mt Ardjuno, *Groenhart* 1860 (L); Mt Gede, *van Ooststroom* 14592 (L); Cibodas Botanical Garden, *Arvidsson & Nilsson* 2487, 2490, 2497 (GB). **Sulawesi:** Lompo Batang, *Zelf* 250 (L). **Papua New Guinea: Eastern Highlands.** Chimbu. Mt Wilhelm, *Borgmann* 779 (B); *Streimann* 18554 (CBG); *Kashiwadani* 10955, 11044, 11186 (TNS); Goroka. Mt Gahavisuki Provincial Park, *Aptroot* 31036 (Herb. Aptroot); Daulo Pass, *Weber & McVean* (COLO). **Madang.** Finisterre Range. Teptep Village, *Aptroot* 31926, 32287 (Herb. Aptroot). **Morobe.** Kewieng, *Koponen* 34404 (Herb. Aptroot); Mt Kaindi, *Streimann* 17523, 17568, 17602, 17614, 17621, 17663–4 (CBG); *Kashiwadani* 10548 (TNS); *Weber & McVean* (COLO); Upper Watut River, *Streimann* 17078 (CBG); Yinimba, *Streimann* 19061, 19711 (CBG); track to

Mt Missim, Bellamy 206 (CBG); Pouyu Village, Streimann & Tamba 12675 (CBG); logging area 15 km E. of Bulolo, Streimann & Bellamy 13166 (CBG); Gumi Divide, Streimann 22774 (CBG); Wau, Edie Creek Road, Sipman 15627 (Herb. Aptroot); head of Black Cat Creek, Streimann 25653 (CBG). **Central.** 2 km N. of Waiotape Airstrip, Kashiwadani 12242, 12260 (TNS); Mt Albert-Edward, Kashiwadani 11719, 11803 (TNS). **Southern Highlands.** Margarima-Tari Road, Streimann 24394 (CBG); Iaro River, Streimann 23950 (CBG). **Western Highlands.** Karpena plantation N. of Mt Hagen, Streimann 21813, 21825 (CBG); Yobobos, Hoogland & Schodde 7640 (COLO). **Solomon Islands: Guadalcanal Island.** Mt Popomansiu, Hill 9439, 9491, 9575, 9849, 9883 (BM). **New Caledonia: Sarramea.** Col d'Amieu, Hill 12021 (BM). **Fiji: Viti Levu.** Nggaliwana Creek Valley, Smith 5335 (L); N-Baluti trail, Selling (S); Mba, Nandarivatu, Smith 5964 (BM); Nandarivatu, Green (BM). **Taveuni.** Mt Utugatau, Degelius P-205, P-230 (UPS). **Samoa: Upolu.** Lanuto'o, Recharging (W). **Tahiti:** Aorai, v. Balgooy (Herb. Aptroot); Onohea Valley, Degelius P-346 (UPS); Belvedere near Papeete, Degelius P-390 (UPS); sine loco, Moseley (BM). **Marquesas Islands: Nukuhiva.** Tovii, Peake (BM).

9. *Pseudocyphellaria insculpta* (Stizenb.) D.J. Galloway in *Lichenologist* 17: 305 (1985). *Stictina insculpta* Stizenb. in *Flora, Jena* 81: 129 (1895). *Stictina impressula* Müll. Arg. in *Flora, Jena* 71: 22 (1888). non Nyl. (*Flora, Jena* 57: 71 (1874), based on *Stictina tomentosa* var. *impressula* Nyl. in *Annls Sci. nat. (Bot.)* V, 7: 305 (1867) from South America). *Sticta insculpta* (Stizenb.) Zahlbr., *Cat. lich. univ.* 3: 388 (1925). Type: Australia. Queensland, Mt Bellenden Ker, Sayer, comm. F. v. Mueller 1887 (G 0020099-holotype).

Fig. 12.

*Stictina diplomorpha* Müll. Arg. in *Flora, Jena* 65: 301 (1882).

*Pseudocyphellaria diplomorpha* (Müll. Arg.) D.J. Galloway, *Tropical lichens: their systematics, conservation & ecology*: 9 (1991). Type: Ceylon [Sri Lanka], sine loco, 1876, G.H.K. Thwaites (G 001975-holotype).

*Stictina impressula* var. *sublaevis* Müll. Arg. in *Hedwigia* 30: 48 (1891). *Stictina insculpta* var. *sublaevis* (Müll. Arg.) Stizenb. in *Flora, Jena* 81: 129 (1895). *Sticta insculpta* var. *sublaevis* (Müll. Arg.) Zahlbr., *Cat. lich. univ.* 3: 388 (1925). Type: Australia. Queensland, Bellenden Ker District, 1889, Bailey 575 pr.p. (G 002105-holotype).

*Thallus* orbicular to irregularly spreading in entangled clones, 5–12(–20) cm diam., loosely attached centrally, margins and apices free,  $\pm$  ascending. *Lobes* very variable, irregularly divided, subdichotomously branching at apices to complex-imbriate centrally, 1–4(–8) mm wide, 0.5–1(–4) cm long. *Margins* irregularly notched or incised, occasionally to densely isidiate or lobulate-phyllidiate. *Upper surface* vivid navy blue to blue-black when wet, olivaceous-grey suffused brownish in parts when dry, irregularly undulate, conspicuously dimpled, punctate-impressed, here and there minutely papillate (use  $\times 10$  lens), rather fragile, papery when dry, flabby when wet, isidiate-phyllidiate, maculate, without pseudocyphellae or soredia. *Maculae* frequent, minute, white, effigurate to  $\pm$  reticulate imparting a delicate marbling to the upper surface. *Phyllidia* mainly marginal, occasionally also laminal, simple to coralloid, terete to flattened-dorsiventral, constricted at base 0.2–0.5(–1) mm wide, 1–2 mm tall. Isidia terete, subgranular at first, becoming flattened-phyllidiate. *Medulla* white. *Photobiont* cyanobacterial. *Lower surface* pale yellow-brown or whitish to buff brown at apices, darkening centrally, glabrous in a narrow to broad marginal zone and tomentose centrally, or uniformly tomentose from margins to centre, tomentum long, silky, white to grey-black or brown-black, densely entangled to  $\pm$  felted-woolly. *Pseudocyphellae* prominent, white, round to

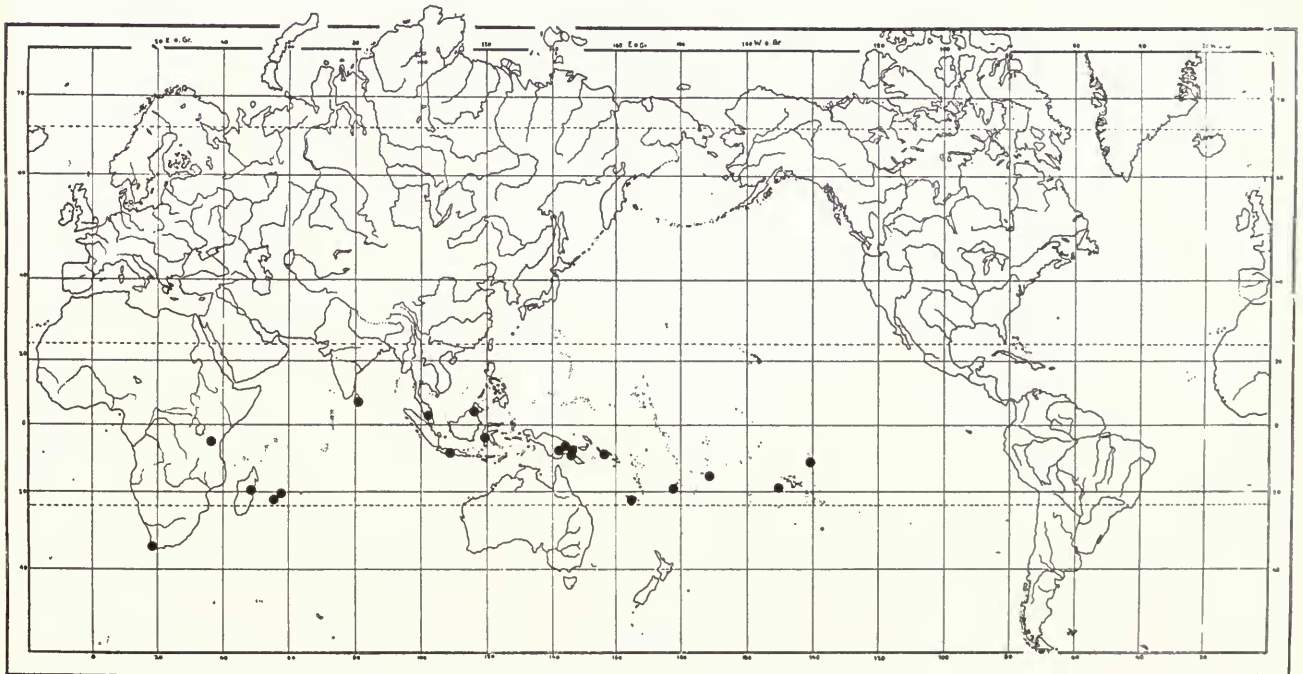


Fig. 11 Distribution of *Pseudocyphellaria desfontainii* in the palaeotropics.

irregular, 0.1–1 mm diam., margins raised, concolorous with lower surface, decorticate area flat to convex, sunk in tomentum.

*Apothecia* rare or absent to occasional, rounded, 1–2(–2.5) mm diam., sessile, constricted at base to  $\pm$  subpedicellate, exciple pale pinkish brown, translucent when wet, wrinkled-striate, with occasional to dense white, silky tomentum below, disc plane to subconcave, red-brown, matt, smooth, epruinose. *Epithecium* pale yellow-brown, 8–12  $\mu$ m thick. *Hymeniun* colourless, 70–85  $\mu$ m tall. *Ascospores* yellow-brown to red-brown 1–3-septate, ellipsoid-fusiform, apices rounded or pointed, 28–33.5  $\times$  6.5–8.5  $\mu$ m.

**CHEMISTRY.** Methyl gyrophorate, gyrophoric acid, 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

**OBSERVATIONS.** *Pseudocyphellaria insculpta* is characterized by a white medulla; a cyanobacterial photobiont; projecting marginal lobules or elongate phyllidia; a dimpled to punctate-impressed upper surface; and a two-hopane chemistry with methyl gyrophorate and gyrophoric acid. It is distinguished from *P. prolificans* and *P. multifida*, both of which have

green photobionts; from *P. beccarii* which has entire margins; from *P. argyracea* and *P. dissimilis* which have terete to coralloid isidia; and from *P. crocatoides* which has yellow pseudocyphellae.

**DISTRIBUTION AND ECOLOGY.** A palaeotropical species known from Sri Lanka to the south-west Pacific (Fig. 13). An epiphyte of trees and shrubs in humid montane rainforest or cloud forest, often growing amongst moss, 300–3760 m.

**SPECIMENS EXAMINED.** **Sri Lanka:** Big Mount, *Neitner* (US); Adams Peak, *Thor* 391 (S); Horton Plains, World's End, *Bohlin* (S); Central Province, *Thwaites* C11, C22 (BM). **Malaysia:** Sabah. Kota Belud. Mt Kinabalu, 1650–3100 m, *Sipman & Tan* 31075, 31383 (B). **Indonesia.** Sumatra: ?Gunung Leuser National Park, *Assink* s.n. (Herb. Aptroot). **Java:** Malang, *Lederer* s.n. (B); Tjibodas. Mt Gede, *Schiffner* 3079 (L); sine loco, *Zollinger* (L); Mt Ardjuno, *Groenhart* 7328 (L). **Philippines:** Luzon. Benguet. Mt Santo Tomas, *Sipman* 21819 (B); sine loco, *Loher* (BM). **Papua New Guinea: Eastern Highlands.** Chimbu. Mt Wilhelm, *Borgmann* 821 (B); *Aptroot* 32880 (Herb. Aptroot); *Kashiwadani* 10843, 10861, 10865, 10912, 10952, 11045, 11450 (TNS); Bundi Gap,

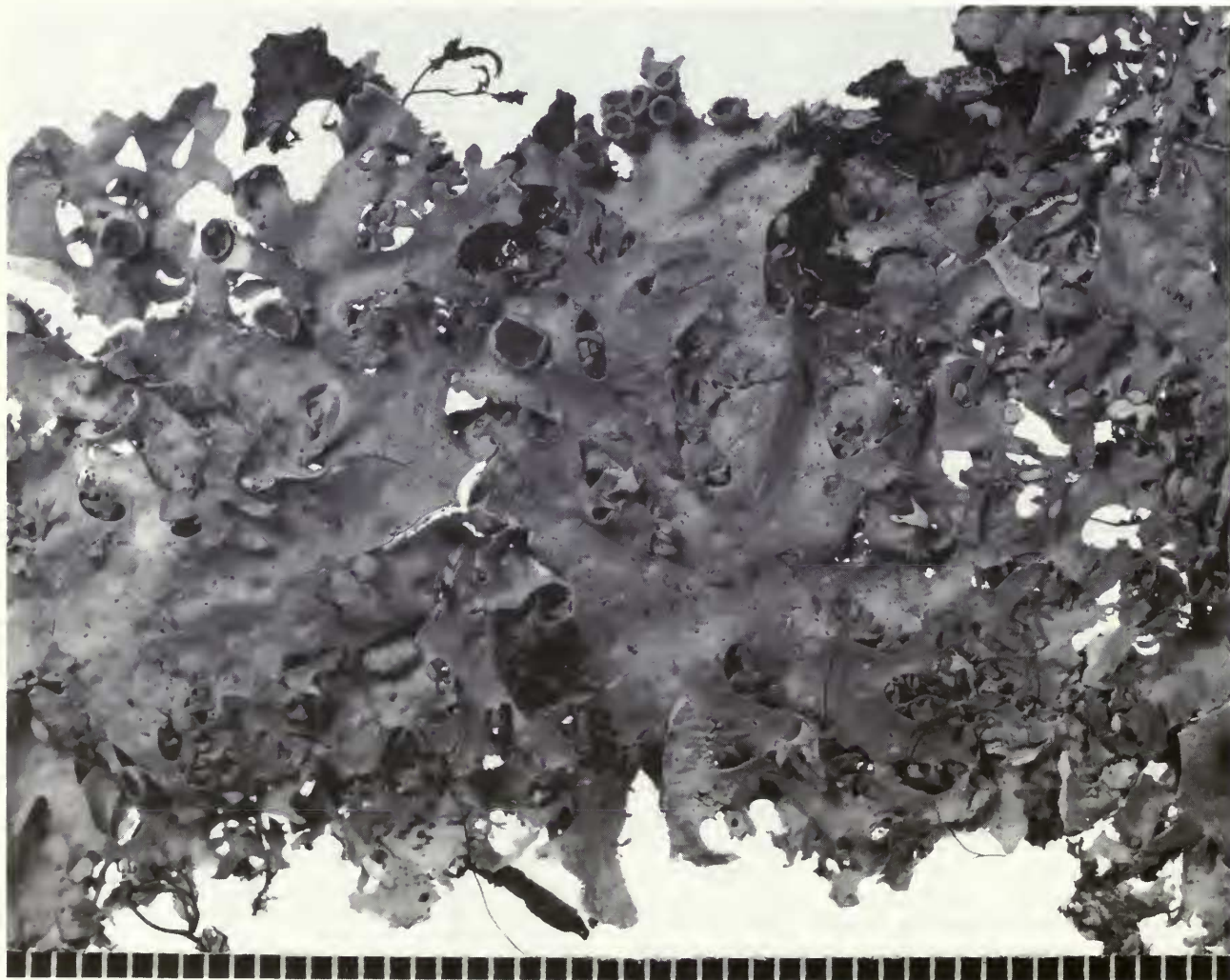


Fig. 12 *Pseudocyphellaria insculpta*. G. Thor 391 (S). Scale in mm.



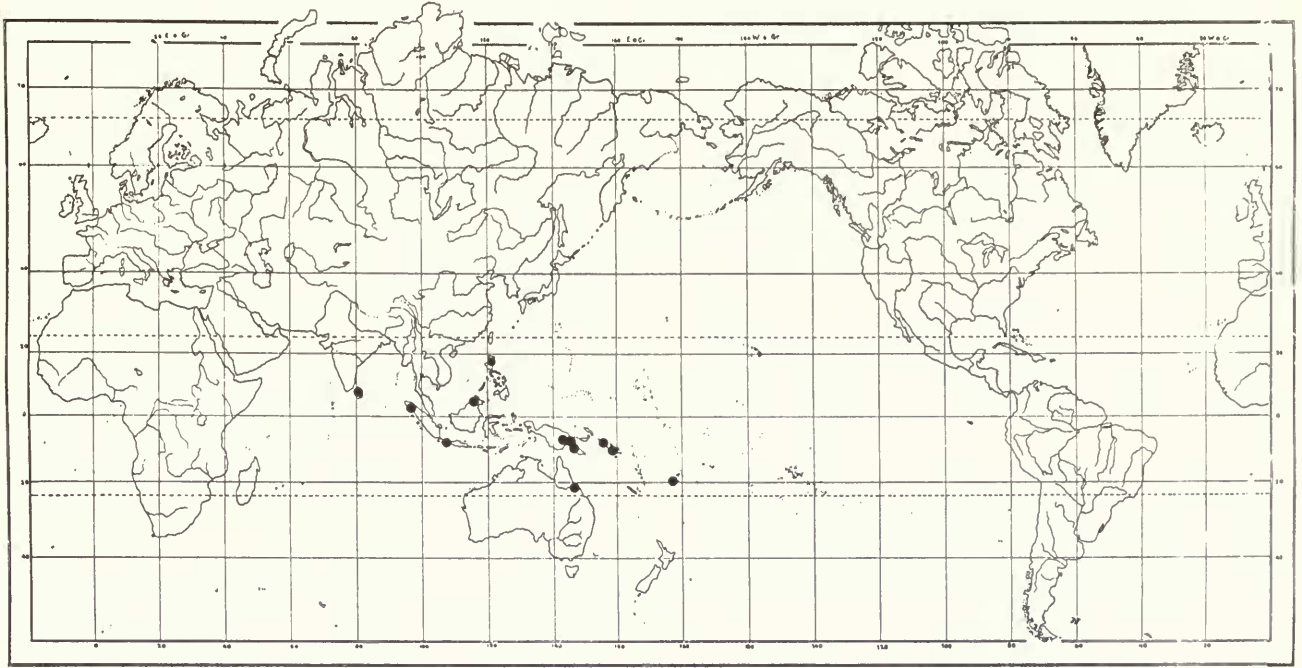


Fig. 13 Distribution of *Pseudocyphellaria insculpta* in the palaeotropics.

*Aptroot* 32197 (Herb. Aptroot); Pindaunde Valley, *Aptroot* 32741 (Herb. Aptroot). **Morobe.** Cromwell Mountains. Siwea, *Koponen* 30489 (Herb. Aptroot); track to Mt Missim, *Bellamy* 210a,c (CBG); Kaisinik, *Kashiwadani* 10738 (TNS); Mt Kaindi, *Streimann* 33207 (CBG). **Central.** Mt Albert-Edward, *Kashiwadani* 11807 (TNS); 2 km N. of Waiotape Airstrip, *Kashiwadani* 12263 (TNS). **Southern Highlands.** Onim Forestry Station, *Streimann* 24627 (CBG). **Solomon Islands: Guadalcanal Island.** Mt Popomansiu, *Hill* 9289, 9315, 9383, 9432, 9435, 9495–6, 9512, 9559–60, 9667 (BM). **Kolombangara Island.** South Summit, *Hill* 10494 (BM). **Fiji: Viti Levu.** Mba, immediate vicinity of Nandarivatu, *Smith* 5964 (US).

10. *Pseudocyphellaria dissimilis* (Nyl.) D.J. Galloway & P. James in *Lichenologist* **12**: 297 (1980). *Stictina fragillima* var. *dissimilis* Nyl., *Syn. meth. lich.* **1**(2): 336 (1860). *Stictina dissimilis* (Nyl.) Nyl. in *J. Linn. Soc. Lond.* **9**: 246 (1866). *Sticta fragillima* var. *dissimilis* (Nyl). *Kremp., Reise Ost Freg. Novara Bot.* **1**: 119 (1870). *Cyanisticta dissimilis* (Nyl.) Räsänen in *J. Jap. Bot.* **16**: 143 (1940). Type: Australia. Sine loco, *Hampe* (H-NYL 34103-lectotype (Galloway & James, 1980: 297)).

*Pseudocyphellaria dissimilis* is dark slate-blue to blue-black when wet, pale greyish to buff when dry; it is a characteristic isidiate palaeotropical species with a white medulla and white pseudocyphellae on the lower surface which is described in detail in Galloway (1988: 122–126).

**CHEMISTRY.** Gyrophoric acid (tr.), 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

**OBSERVATIONS.** *Pseudocyphellaria dissimilis* is a highly variable palaeotropical species having linear-elongate to shallowly rounded, subdichotomously to irregularly branched lobes, often  $\pm$  canaliculate and with entire margins becoming

isidiate or occasionally also phyllidiate. The upper surface is smooth or shallowly wrinkled, glossy or matt, minutely maculate and papillate ( $\times 10$  lens), and with laminal and marginal isidia, and/or phyllidia. Isidia are simple,  $\pm$  terete at first and later may become coralloid-branched or flattened and  $\pm$  phyllidiate. It has a white medulla, a cyanobacterial photobiont, and a pale to brownish often  $\pm$  costate lower surface with rather sparse, short central tomentum and scattered, fleck-like pseudocyphellae. Spores are pale yellow-brown, 1–3-septate, straight or slightly curved, apices rounded or pointed, 20.5–29.5  $\times$  7–9  $\mu$ m. It has a basic two-hopane chemistry (Wilkins, 1993) with or without traces of gyrophoric acid. Its physiology is discussed in Green et al. (1991) and Lange et al. (1993). It is distinguished from *P. insculpta* in lacking a punctate-impressed upper surface; from *P. argyracea* in lacking laminal pseudocyphellae associated with isidia; from *P. desfontainii* which has yellow pseudocyphellae and a different chemistry; and from *P. crocatoides* which has marginal and laminal proliferations, yellow pseudocyphellae and a different chemistry.

**DISTRIBUTION AND ECOLOGY.** Apparently rather rare in the palaeotropics where it has to date been positively identified only from Papua New Guinea and Norfolk Island collections from montane rainforest. It is common in north-eastern Australia and throughout New Zealand (Galloway, 1988) and is also recorded from Juan Fernandez but not from continental South America (Galloway, 1992).

**SPECIMENS EXAMINED.** **Papua New Guinea: Eastern Highlands.** Goroka. Mt Zapaliga, *Iserentant* 9534 (Herb. Aptroot). **Norfolk Island:** sine loco, sine coll. (MEL).

11. *Pseudocyphellaria dozyana* (Mont. & Bosch) D.J. Galloway in *Lichenologist* **17**: 304 (1985). *Sticta dozyana* Mont. & Bosch, *Syll. gen. sp. crypt.*: 326 (1856). *Stictina dozyana* (Mont. & Bosch) Nyl., *Syn. meth. lich.* **1**(2): 335 (1860).

*Saccardo dozyana* (Mont. & Bosch) Trevis., *Lichenotheca veneta* exs. no. 75 (1869). Type: Java, without specific locality or date of collection, *Junghuhn* (L 910,215-1471-lectotype (Galloway & Arvidsson, 1990: 128)).

NOTE. Material in PC-HUE is similar in all respects to the Leiden specimen, both are fertile having young, immature, marginal fruits and obviously represent parts of the same collection. The Paris material has a printed label 'Herbarium R.B. van den Bosch' and is further labelled in van den Bosch's hand 'Sticta intricata Del. Java Junghuhn', to which Montagne has added 'Sticta Dozyana M. et V.d.B.'.

*Stictina mougeotiana* var. *albocyphellata* Nyl., *Syn. meth. lich.* 1(2): 341. 1860. Type: Ins Bourbonia [Réunion], without specific locality, collector or date (H-NYL 33995-holotype).

*Pseudocyphellaria dozyana* belongs to the *P. crocata* group (white medulla, cyanobacterial photobiont and a chemistry dominated by stictic acid metabolites and hopane-6 $\alpha$ , 7 $\beta$ , 22-triol) and has a punctate-impressed to faveolate upper surface with characteristic white marginal soralia with a pale yellow tinge to the exposed medulla beneath the white soralia.

CHEMISTRY. Tenuiorin, methyl gyrophorate, hopane-6 $\alpha$ , 7 $\beta$ , 22-triol, stictic, constictic, cryptostictic acids and traces of unidentified triterpenes.

OBSERVATIONS. *Pseudocyphellaria dozyana* is dark slate-blue to blue-black when wet, pale glaucous-greyish when dry; it has a white medulla, a cyanobacterial photobiont, white pseudocyphellae on the lower surface (rarely these may be pale yellowish at margins), and conspicuous, sinuous, marginal soralia containing grey-white, granular soredia often eroding faint yellowish below. Lobes are broadly elongate-laciniate and are conspicuously punctate-impressed to faveo-

late. The broadly elongate-laciniate lobes and the prominent punctate-impressed to faveolate upper surface, the white marginal soralia and the mainly white pseudocyphellae distinguish this species from *P. crocata* which has prominent yellow soralia and yellow pseudocyphellae, and from *P. bartlettii* which has broadly rounded,  $\pm$  rosette-forming lobes with reticulate soralia. *P. intricata* has a smooth upper surface with scattered laminal and marginal soralia which never erode yellowish below, and its chemistry is different, having two hopane-diol triterpenoids and lacking the stictic acid complex of metabolites. Montagne & van den Bosch's record of *Sticta granulata* from Java (Montagne & van den Bosch, 1857: 437-438) evidently refers to *P. dozyana* (Groenhart, 1936).

DISTRIBUTION AND ECOLOGY. A palaeotropical species ranging from the Uluguru Mountains in East Africa and Madagascar and Réunion in the Indian Ocean to the Galapagos Islands (Weber, 1993) in the eastern Pacific (Fig. 14). Known also from Ecuador (Galloway & Arvidsson, 1990). On living and dead trees and shrubs in humid primary and secondary rainforest, 550-2000 m.

SPECIMENS EXAMINED. **Africa. Tanzania:** Uluguru Mountains, Mindu Hill near Morogoro, *Pocs & Ochyra* 88102/AO (BM). **Madagascar:** near Aulanarin, *Pool* (BM). **Réunion:** Cirque de Cilaos: Aufsteig von der Strasse zwischen Cilaos und Ilet a Cordes aud den Col du Taibit, *K. & A. Kalb* 26565, 26566 (Herb. Kalb); Piton des Neiges, 1500 m, *Arvidsson & Nilsson* (GB). **Indonesia. Sulawesi.** Sine loco, *Herb. Lugd. Batav.* (L); Manado, *Quindal* (M). **Java.** Sine loco, *Junghuhn* s.n. (L); Mt Merbabu, *Surjanto* 1608 (L); sine loco, *Junghuhn* (L); Mt Gede, *Schiffner* 1149 (L); sine loco, sine coll. (H-NYL 34070, 34072). **Papua New Guinea: Eastern Highlands.** Goroka. Lutheran Guesthouse, *Sipman* 22324 (B). **Central.** Near Dabamura, 40 km NE of Port Moresby, *Streimann & Naoni* 14957 (CBG). **Morobe.** Herzog Mountain, *Streimann & Umba* 11050 (CBG). **Western Highlands.**

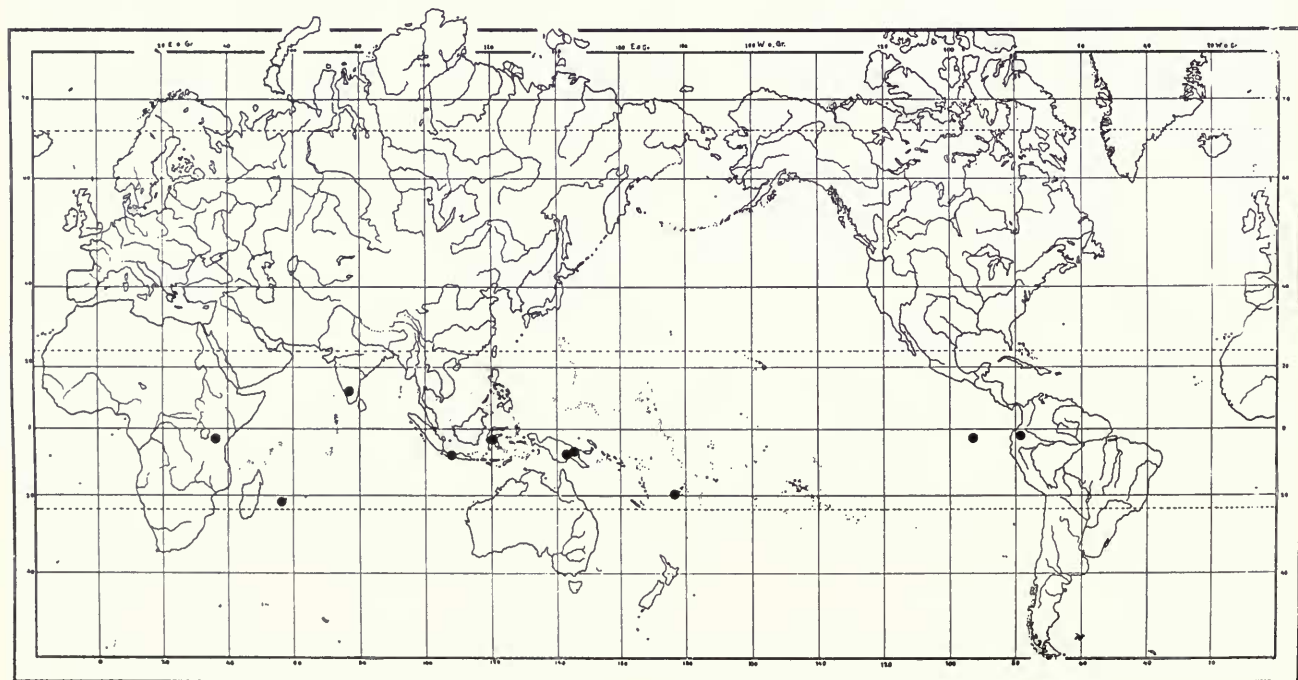


Fig. 14 Distribution of *Pseudocyphellaria dozyana* in the palaeotropics.

Baiyer River Sanctuary, *Streimann* 21042 (CBG); Kagamuga, *Streimann* 24787 (CBG). **Fiji:** *Viti Levu*. Mba, slopes of Mt Nairoso, eastern flank of Mt Evans Range, *Smith* 4100 (US). **Galapagos Islands:** *Isla Santa Cruz*. Table Mt, *Weber* 288 (COLO). *Isla Santiago*. Above James Bay, *Pike* 2732 (COLO). *Isla Charles*. *Weber* 443 (COLO); trail from Black Beach to highlands, *Weber & Lamer* (COLO).

12. *Pseudocyphellaria gilva* (Ach.) Malme in *Bih. K. svenska Vetenskakad. Handl.* **25**(3/6): 32 (1899). *Lichen gilvus* Ach., *Lichenogr. succ. prod.*: 157 (1799) ['1798']. *Sticta gilva* (Ach.) Ach., *Methodus*: 278 (1803). *Sticta crocata* var. *gilva* (Ach.) Ach., *Syn. meth. lich.*: 232 (1814). *Stictina gilva* (Ach.) Nyl., *Syn. meth. lich.* **1**(2): 339 (1860). *Saccardoia gilva* (Ach.) Trevis., *Lichenotheca Veneta* exs. 75 (1869). *Cyanisticta gilva* (Ach.) Gyeln. in *Reprrium Spec. nov. Regni veg.* **29**: 5 (1931). Type: [South Africa] Cap.b.Spei, *Thunberg* (UPS-THUNBERG 26816-lectotype (Galloway, 1992: 130)).

*Cyanisticta gilva* var. *lanata* (Pers.) Gyeln. in *Reprrium Spec. nov. Regni veg.* **29**: 5 (1931). *Collema lanata* Pers. in *Gaudich., Voy. Uranie*: 204 (1827). Type: In insulis Maclovianis [Falkland Is], *Gaudichaud* (?PC-not seen).

*Cyanisticta gilva* var. *pseudogilva* Gyeln. in *Reprrium Spec. nov. Regni veg.* **29**: 6 (1931). Type: South Africa 'Promontorium Bonae Spei', *Gueinzus* (B-holotype).

*Cyanisticta gilva* var. *philippiana* Gyeln. in *Reprrium Spec. nov. Regni veg.* **29**: 6 (1931). Type: Philippines. Luzon, Benguet Subprovince, May 1911, *E.D. Merrill* 7962 (B-holotype; B-isotype).

*Pseudocyphellaria lombokensis* H. Magn. in *Acta Horti gothoburg.* **14**: 26 (1940). Type: [Java] East India. Lombok, Goenoeng Rindjani, 1925, *T.Å. Tengvall* (?UPS- not seen).

*Pseudocyphellaria gilva* described originally from Table Mountain at the Cape of Good Hope in the eighteenth century (Galloway, 1992) is a palaeotropical species in the *P. crocata* complex of taxa, having a white medulla, a cyanobacterial photobiont, yellow pseudocyphellae on the lower surface and hopane-6 $\alpha$ , 7 $\beta$ , 22-triol as the principal terpenoid present in the medulla. Spores are red-brown, 1–3-septate, fusiform-ellipsoid, apices pointed, 22–30  $\times$  9–11  $\mu$ m. The species is described in detail in Galloway (1992: 130–135).

**CHEMISTRY.** Tenuiorin, methyl gyrophorate, hopane-6 $\alpha$ , 7 $\beta$ , 22-triol, stictic, cryptostictic, constictic, salazinic (tr.) and norstictic (tr.) acids, calycin, pulvinic acid and pulvinic dilactone.

**OBSERVATIONS.** *Pseudocyphellaria gilva* is livid slate-blue suffused red-brown in parts when wet, pale grey-brown, olivaceous-brown to brown-black when dry; it has a white medulla; a cyanobacterial photobiont; irregularly branching to imbricate lobes with  $\pm$  subdichotomously branching apices, entire margins often with conspicuous, yellow pseudocyphellae; a glossy, undulate to subfaveolate upper surface, lacking soredia, isidia, maculae or phyllidia; a dark red-brown to black lower surface with conspicuous, conical-verruciform, yellow pseudocyphellae; apothecia are rare to frequent, young fruits with a characteristic red-ochre margin to the disc which may sometimes be slightly grey-pruinose. It shows a wide range of variation throughout its range (Galloway, 1992: 133). It is distinguished from *P. crocata* by lacking

soredia; from *P. crocatoides* in the thicker, darker thallus and the absence of marginal proliferations; from *P. desfontainii* in the absence of isidia; from *P. beccarii* in having a cyanobacterial photobiont, yellow pseudocyphellae and a different chemistry. The palaeotropical taxon with which it has been confused (see Magnusson, 1940), *P. carpoloma*, has a green photobiont, much more divergent, dichotomously branching lobes and a different chemistry (Code D of Wilkins & James (1979)).

**DISTRIBUTION AND ECOLOGY.** A palaeotropical species (Fig. 15) ranging from South Africa (the type locality is Table Mountain) through the south-west Pacific tropics to southern South America (Galloway, 1992). On trees and shrubs, amongst mosses and overgrowing rocks in humid montane forest or cloud forest, 250–3600 m. Also in eastern Australia from Queensland to Tasmania.

**SPECIMENS EXAMINED.** **Africa. South Africa:** Kirstenbosch, *Almborn* [Lichenes africans 9] (BM, L); Table Mt, *Garside* (L); *Sipman* 20.165, 20.194 (B); *Eaton* (BM); *McGillivray* (BM); Simon's Bay, *Wright* (BM); Cape, *Drège* (BM). **Mauritius:** sine loco, *Blackburn* (BM). **Malaysia: Sabah.** Mt Kinabalu, *Samsudin* (UKMB). **Indonesia. Java:** sine loco. *Horsfield* (BM); Mt Ardjuno, *Groenhart* 26, 32, 42, 1857, 1858, 1871 (L); Mt Kawi/Mt Panderman, *Groenhart* 1825, 1956, 7262, 7263, 7264, (L); Mt Merbabu, *Surjanto* 1612 (L); Tjemorokandang, *Groenhart* 7261 (L). **Philippines: Luzon.** Benguet, Pauai, 2100 m, *McGregor* 8528 (B); *Merrill* 7962, 7972 (BM); Mt Santo Tomas, *Sipman* 21777d (B); *Aptroot* 20358 (Herb. Aptroot); *Degelius* As-854, As-876 (UPS). **Mindanao.** Mt Apo, *Copeland* 1089, 1092 (B, MEL). **Papua New Guinea: Eastern Highlands.** Chimbu. Mt Wilhelm, *Weber & McVean* (B, COLO); *Aptroot* 18211, 32828 (Herb. Aptroot); *Borgmann* 756, 934, 936 (B); *Kashiwadani* 10883, 10916, 10965, 10975, 10980, 10997, 11095, 11127, 11291, 11400, 11404, 11428, 11467 (TNS); *McVean* 6699, 66189 (CBG); *Wade* 8065 (COLO); *Weber* [Lich. Exs. 373] (BM); Pindaunde Valley, *Sipman* 15908, 21988 (B); Bundi Gap, *Aptroot* 32550); Kombugomambuno, *Mundua* 139 (CBG); 2 km N. of Chimbu Airstrip, *Kashiwadani* 12432 (TNS); Lake Aunde, *Aptroot* 18462, 18477 (Herb. Aptroot); Goroka. Mt Gahavisuki Provincial Park, 2400 m, *Aptroot* 31029, 31140 (Herb. Aptroot); *Streimann* 18204 (CBG); *Siman* 22193 (B); Daulo Pass, *Hoffmann* 89–441 (Herb. Aptroot); *Streimann* 17968, 18080, 18116 (CBG); Wopeia. Near Aiyura, *Streimann* 18328 (B); track to Mt Michael, *Streimann* 18475 (CBG); near Hogabi Village, *Streimann & Bellamy* 18687 (CBG); Kassam Pass, *Streimann & Umba* 11427–8, 11504 (CBG). **Morobe.** Saruwaged, *Sipman* 24385 (B); Mt Sarawaket [Saruwaged] Southern Range, *Koponen* 32731 (Herb. Aptroot); Hekwangi Village, *Streimann* 19362 (B); track to Mt Missim, *Bellamy* 210a.c (CBG); Upper Watut River, *Streimann* 17179, 17239 (CBG); Mt Kaindi, *Streimann & Bellamy* 17675, 19875 (CBG); *Streimann* 22495, 22510 (CBG); Yakwoi River, *Streimann* 19261 (CBG); Rawlinson Range, *Strong Clemens* 12444 (COLO); Pouyu Village, *Streimann & Tamba* 12712 (CBG); Ekuti Divide, *Streimann* 20173, 24932 (CBG); head of Black Cat Creek, *Streimann* 25643, 25646–7 (CBG); Logging Area 15 km W. of Bulolo, *Streimann & Bellamy* 13142 (CBG); near Hunzeukngon Village, *Aptroot* 18023 (Herb. Aptroot); Gumi Divide, *Streimann* 25062 (CBG). **Western Highlands.** Mt Karoma, *Veldkamp & Wiakabu* (Herb. Aptroot); Baiyer River Sanctuary,

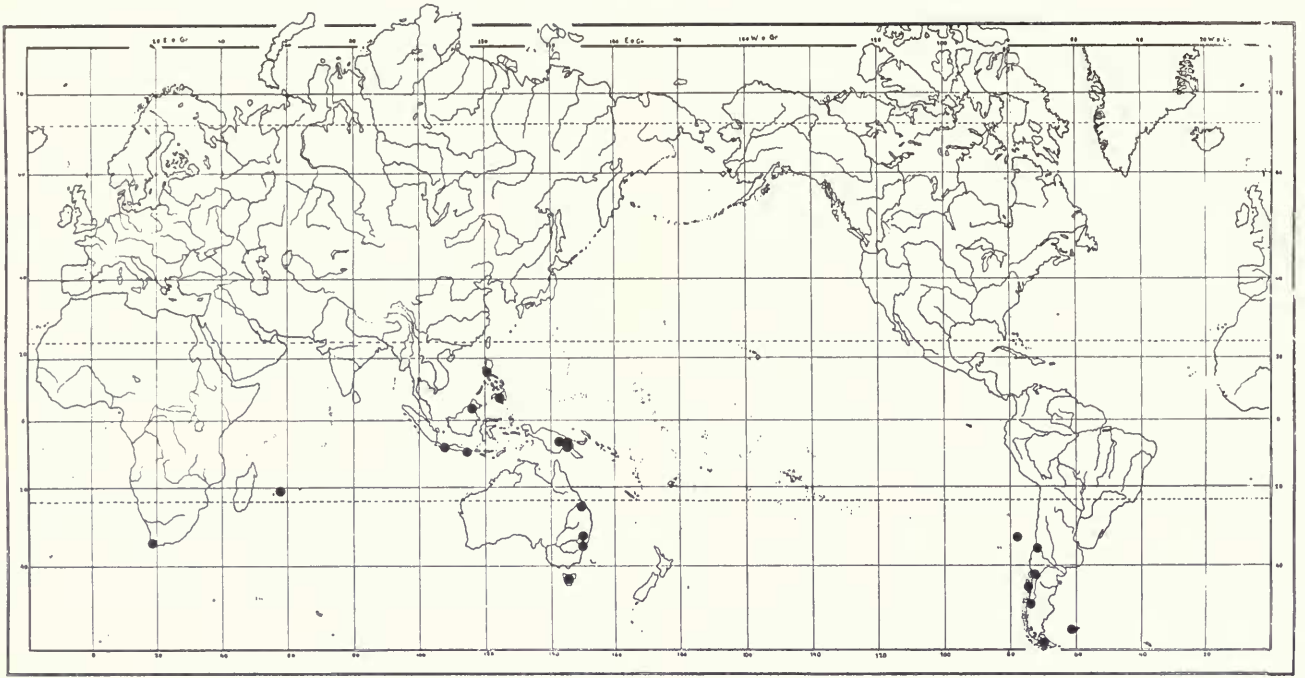


Fig. 15 Distribution of *Pseudocyphellaria gilva* in the palaeotropics.

*Streimann* 21116 (CBG); Tumbang Village, *Streimann* 21361 (CBG); Mur Mur Pass, *Streimann* 21174 (CBG). **Madang.** Finisterre Range, Teptep Village, *Aptroot* 31982, 31992, 32292, 32294 (Herb. Aptroot). **Southern Highlands.** Lai River, *Streimann* 22213, 22216 (CBG); Iaro River, *Streimann* 23827, 23837 (CBG); Munia Logging Area, *Streimann* 23320, 23325, 23666 (CBG); Lama Sawmill Logging Area, *Streimann* 24690 (CBG); Paunde Logging Area, *Streimann* 23346, 23354 (CBG). **Enga.** Mape Creek, *Streimann* 21555 (CBG).

13. *Pseudocyphellaria godeffroyi* (Kremp.) D.J. Galloway in *Lichenologist* 17: 304 (1985). *Sticta* (*Stictina*) *godeffroyi* Kremp. in *J. Mus. Godeffroy* 1(4): 99, tab. 14 fig. 10 (1874). Type: Fiji, Viti Levu, Noggara, *Dr E. Gräffe* 67 (M-lectotype (Galloway, 1985: 304)).

Fig. 16.

*Stictina intricata* var. *gymnoloma* Nyl., *Syn. meth. lich.* 1(2): 335 (1860). Type: Fidji insulae, *Milne* (H-NYL 34090-lectotype (Galloway, 1985: 304)).

*Thallus* rosette-forming, wide-spreading, 5–12(–25) cm diam., closely attached centrally, margins  $\pm$  free. *Lobes* broadly rounded, 8–15(–20) mm diam., contiguous to overlapping at margins, imbricate centrally. *Margins* entire, sinuous, shallowly to deeply notched, slightly thickened. *Upper surface* dark glaucous blue to dark malachite green-blue, suffused brownish at apices when wet, pale buff brown or red-brown to pale cinnamon brown when dry, undulate, irregularly pitted or shallowly wrinkled in places, minutely roughened to verrucose-scabrid, scabrosity best seen at lobe apices (use  $\times 10$  lens), apices minutely white-tomentose, coriaceous, tough when dry, pliable, flabby when wet, pseudocyphellate, without isidia, phylidia or soredia. *Pseudocyphellae* white, round to irregular, scattered, occa-

sional to frequent, 0.2–1.5 mm diam., large prominent pseudocyphellae  $\pm$  ulcerose with a raised margin, decorticate area flat to concave. *Medulla* white. *Photobiont* cyanobacterial. *Lower surface* pale yellowish buff or brownish at margins, darkening centrally, uniformly short velvety tomentose, tomentum very even, pale buff to dark red-brown. *Pseudocyphellae* white, prominent, scattered, often crowded, minute, at margins 0.1–0.3 mm diam., larger centrally, round to irregular, 1–2 mm diam., margins very shallowly raised, concolorous with lower cortex, decorticate area flat to concave, distinctly granular-roughened.

*Pycnidia* prominent, solitary or crowded, marginal and laminal, raised, to 0.5 mm diam., hemispherical, ostiole red-brown, 0.1–0.2 mm diam.

*Apothecia* sparse to frequent, often crowded at centre of thallus, rare at margins and lobe apices, sessile, constricted at base, round to irregular-deformed through mutual pressure, 1–3 mm diam., exciple prominent, persistent, pale brownish, conspicuously verrucose-scabrid forming a distinctive corrugate-scabrid margin to disc, disc concave to plane, pale to dark red-brown, shining, epruinose. *Epitheciun* pale red-brown, 14–22  $\mu$ m thick. *Hymenium* colourless to pale straw, 80–95  $\mu$ m tall. *Ascospores* 1–3-septate, pale yellow-brown to red-brown, fusiform-ellipsoid, apices rounded or pointed, straight or curved, 28–33.5  $\times$  (5.5–)6.5–8.5(–11)  $\mu$ m.

CHEMISTRY. 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

OBSERVATIONS. *Pseudocyphellaria godeffroyi* is characterized by a white medulla, white pseudocyphellae on both upper and lower surfaces, a cyanobacterial photobiont, and broad rounded lobes with a distinctive-scabrid-areolate upper surface. It is distinguished from *P. punctillaris* which has a scabrid-areolate upper surface and isidia or lobules at the margins; from *P. rigida* which has a scrobiculate upper



Fig. 16 *Pseudocyphellaria godeffroyii*. T.G.A. Green s.n. (BM). Scale in mm.

surface (not areolate-scabrid); from *P. semilanata* which has a smooth, not areolate-scabrid upper surface; and from *P. trichophora* which has a smooth upper surface and distinctive tomentose-hairy lobe margins.

**DISTRIBUTION AND ECOLOGY.** Apparently restricted to Fiji where it occurs on trees in open slopes and on trees and scrub in humid, montane rainforest, 700–1100 m.

**SPECIMENS EXAMINED.** **Fiji:** Viti Levu. Sine loco, Milne (BM); Mba, Nandarivatu, Smith 5963 (BM); Nandarivatu, Green (BM); Naggarra, Graeffe 64, 69 (M).

14. *Pseudocyphellaria haywardiorum* D.J. Galloway in *Bull. Br. Mus. nat. Hist. (Bot.)* 17: 159 (1988). Type: New Zealand. North Island, South Auckland, Red Mercury Island, on tea tree (*Leptospermum*) bark, August 1971, B.W. & G.C. Hayward H 40.4 (AK 161261-holotype).

*Pseudocyphellaria haywardiorum* is a palaeotropical species of rather limited distribution in the South Pacific. It is discussed in detail in Galloway (1988: 159–162) and in Elix et al. (1992).

**CHEMISTRY.** 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

**OBSERVATIONS.** *Pseudocyphellaria haywardiorum* is a palaeotropical sorediate species having  $\pm$  rounded to irregularly lacinate lobes with coarsely granular to pseudoisidiate ( $\times 10$  lens) laminal and marginal soralia, and a conspicuously punctate-impressed upper surface. Neither surface depressions nor soralia are arranged in a reticulate pattern. It has a white medulla, a cyanobacterial photobiont, and prominent, large, white pseudocyphellae on the lower surface well delimited from the densely and evenly red-brown to brown-black tomentum. Thalli are dark grey-blue to blue-black when moist, olive brown to yellow-grey when dry. Apothecia very rare, generally absent. Spores fusiform-ellipsoid, apices pointed, yellow-brown, 1-septate (27.5–)30–32(–34)  $\times$  6–7  $\mu$ m. It has a simple two-hopane chemistry.

*P. haywardiorum* is distinguished from *P. intricata* by the punctate-impressed upper surface and the  $\pm$  bullate lower surface with its prominent, large, raised pseudocyphellae, characters which also separate it from the isidiate species *P. argyrea*. It is separated from *P. dozyana* by the punctate-

impressed upper surface and the chemistry (*P. dozyana* is in the *P. crocata* group and has stictic acid metabolites and a hopane triol, and not just the two hopane-diols of *P. haywardiorum*).

**DISTRIBUTION AND ECOLOGY.** In the region known to date only from Norfolk Island where it is rare, occurring on *Araucaria heterophylla* and a tree fern stem (Elix et al., 1992). Known also from northern New Zealand and eastern Australia (Queensland and New South Wales).

15. *Pseudocyphellaria homalosticta* Vain. in *Philipp. J. Sci. Sect. C, Bot.* **8**: 117 (1913). Type: Phillipines. Luzon.

Prov. Rizal. Ad truncos arborum, February 1911, *M. Ramos*, Forest Bureau 13453 (TUR-VAINIO 10317-holotype).

Fig. 17.

*Pseudocyphellaria amphistictoides* Vain. in *Univ. Calif. Publ. Bot.* **12**: 6 (1924). Type: Tahiti. Fautaua Valley, May 1922, *W.A. Seitchell & H.E. Parks* 5443 (BM-isotype).

*Thallus* 3–10(–14) cm diam., irregularly spreading, loosely attached centrally, margins and apices ascending. *Lobes* (1–)2–6(–8) mm diam., subdichotomously to intricately branched. *Margins* entire at apices, soon becoming isidiate-



Fig. 17 *Pseudocyphellaria homalosticta*. Holotype (TUR-VAINIO 10317). Scale in mm.

phyllidiate or proliferating into long, narrow lobules, slightly thickened, ridged below, scattered white pseudocyphellae present, sometimes appearing  $\pm$  sorediate. *Upper surface* bright lettuce green when wet, pale olive green or buff brownish when dry, brittle, fragile, easily damaged when dry, pliable when wet, maculae and soredia absent. *Isidia* common, very variable, terete, simple at first becoming 1–3-branched to coralloid, 0.1 mm diam., to 5 mm long, becoming dorsiventral and phyllidiate, primarily marginal, rarely developing from margins of laminal pseudocyphellae. *Phyllidia* developing from terete isidia or intermixed and independent of them, dorsiventral, with minute pseudocyphellae below, elongate, to 5 mm long. *Pseudocyphellae* white, scattered, punctiform, 0.1 mm diam. or less,  $\pm$  flat, occasionally with isidia developing from margins. *Medulla* white. *Photobiont* green. *Lower surface* pale whitish buff at margins, darkening centrally, occasionally  $\pm$  blackened at centre, glabrous, matt or glossy from margins to centre, or with scattered, thin tomentum centrally. *Pseudocyphellae* white, prominent, widely scattered, conical-verruciform, rounded, 0.1–0.3 mm diam., margins not prominent.

*Pycnidia* solitary,  $\pm$  marginal, hemispherical, 0.1 mm diam. or less, ostiole punctate, dark red-brown.

*Apothecia* rare, marginal, rounded, 0.5–1.5 mm diam., subconvex to plane, sessile, constricted at base, exciple minutely corrugate-scabrid, persisting as verrucose margin to disc, pale buff or pinkish, translucent when wet, disc pale to dark red-brown, smooth, epruinose. *Epithecium* pale yellow-brown, 8–12  $\mu$ m thick. *Hymenium* colourless, 70–85  $\mu$ m tall. *Ascospores* pale yellow-brown, 1-septate, fusiform-ellipsoid, apices rounded or pointed, 25–28  $\times$  6.5–8  $\mu$ m.

**CHEMISTRY.** Methyl gyrophorate (tr.),  $\pm$  gyrophoric and congyrophoric acids, 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

**OBSERVATIONS.** *Pseudocyphellaria homalosticta* has a white medulla, a green photobiont and white pseudocyphellae on both upper and lower surfaces and characteristically at the margins of lobes where they can sometimes appear  $\pm$  sorediate. It has marginal and occasionally laminal terete isidia which may become dorsiventral flattened phyllidia. It has a basic two-hopane chemistry, with or without accessory depsides. It is distinguished from *P. prolificans* which has marginal and laminal phyllidia and lobules, and a punctate-impressed upper surface which is without pseudocyphellae; from *P. multifida* which has a smooth upper surface without pseudocyphellae and simple to squamiform phyllidia; and from *P. reineckeana* which has entire margins without phyllidia or isidia.

**DISTRIBUTION AND ECOLOGY.** A species endemic to the south-west Pacific where it occurs from Fiji eastwards to the Marquesas Islands (Fig. 18). It is an epiphyte of trees and shrubs in dense, montane rainforest, 900–1200 m.

**SPECIMENS EXAMINED.** **Fiji:** Viti Levu, Nandarivatu, *Asplund* s.n. (BM, Herb. L. Arvidsson); *Degener* 31811 (Herb. Aptroot); Mt Nanggaranambuluta [Lomalangi], *Smith* 4818 (BM, L); *Smith* 4833 (BM); ridge between Mt Nanggaranambuluta and Mt Namama east of Nandarivatu, *Smith* 5009 (L); Mt Victoria, *Lam* 6824 (L); *Green* (BM). **Ovalu.** Sine loco, *Gräffe* (W). **Rarotonga:** Tiriora, *Parks* 22395 (COLO); sine loco, *Parks & Parks* 22363a (COLO). **Marquesas Is:** Ua Pu, *Jones* 1178 (Herb. Aptroot). **Nuku Hiva.** Tovii, *Peake* (BM).

16. *Pseudocyphellaria intricata* (Delise) Vain. in *Hedwigia* 37: 35 (1898). *Sticta intricata* Delise in *Mém. Soc. linn. Normandie* 2: 96 pl. 7 fig. 33 (1825). *Stictina intricata* (Delise) Nyl., *Syn. meth. lich.* 1(2): 334 (1860). *Cyanisticta intricata* (Delise) Gyeln. in *Lilloa* 3: 76 (1938). Type: Ile de Bourbon [Réunion], *Bory de St-Vincent* (PC-

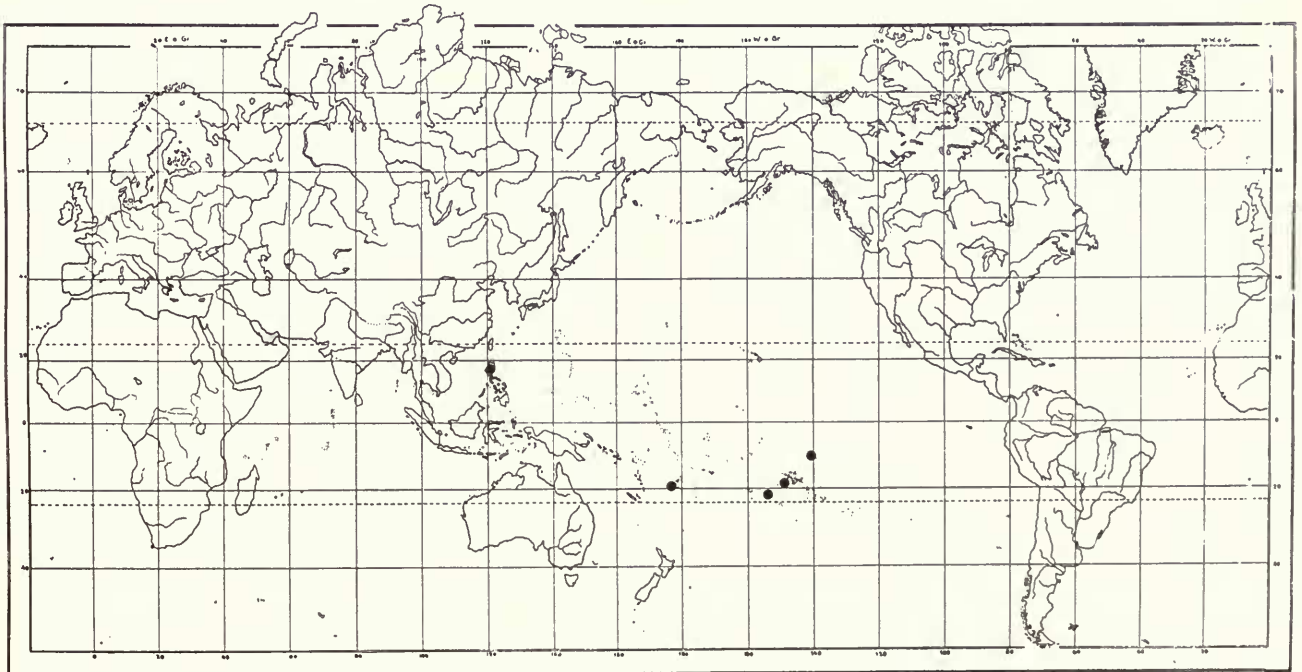


Fig. 18 Distribution of *Pseudocyphellaria homalosticta*.

LENORMAND-lectotype (Galloway & James, 1986: 437 (1986)). For additional synonymy see Galloway & James (1986: 437) and Galloway (1988: 169).

*Sticta dolera* Hue in *Nouv. Archs Mus. Hist. Nat. Paris* IV, 3: 98 (1901). Type: [Réunion] Ins. Bourbon, sine loco, *Lepervanche-Mezières* (PC-HUE 769-lectotype, selected here).

*Cyanisticta philippinica* Gyeln. in *Reprim Spec. nov. Regni veg.* 29: 298 (1931). Type: Philippines, Luzon, Prov. Benguet, Pauai, 2100 m, *R.C. McGregor* (D-not seen).

*Pseudocyphellaria intricata* is a widespread cosmopolitan species having a wide range of variation and paralleling the diversity of morphology seen in *P. crocata*. For a detailed description of the species see Galloway (1988: 169–174).

CHEMISTRY. Tenuiorin (tr.), methyl gyrophorate (tr.), 7 $\beta$ -acetoxypopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

OBSERVATIONS. *Pseudocyphellaria intricata* is dark slate-blue to blue black when wet, pale greyish to buff when dry; it has irregularly lacinate to somewhat rounded lobes, with sinuous, incised or  $\pm$  entire, generally sorediate margins. It has a white medulla, a cyanobacterial photobiont, a pale buff to brown, tomentose lower surface with occasional, scattered, white pseudocyphellae and a  $\pm$  shining upper surface which may have scattered, erose, white to brownish laminal soralia. It has a characteristic, basic two-hopane chemistry (Galloway, 1988; Wilkins, 1993). It is distinguished from *P. haywardiorum* by its smooth upper surface and its lower surface which is not bullate; from *P. argyracea* which has terete isidia associated with the laminal pseudocyphellae; and from *P. dozyana* which has a faveolate upper surface and hopane-6 $\alpha$ , 7 $\beta$ , 22-triol as a major metabolite.

DISTRIBUTION AND ECOLOGY. Widespread throughout the

tropics and also in cool temperate regions of the world (Galloway, 1988, 1992; Galloway & Arvidsson, 1990). In the palaeotropics (Fig. 19) it occurs in humid, shaded woodland and montane forest and cloud forest from 400 to 2000 m (to 3600 m in New Guinea). It is nowhere a common species.

SPECIMENS EXAMINED. **Africa. Kenya:** Mt Kenya east side, Themwe, *Swinscow* (BM); 2 km west of Irangi Forest Station, *Swinscow* (BM). **South Africa:** Smith's Peak, *Leighton* 942 (L); Knysna, *Alborn* [Lichenes africana 10] (L); *Werdermann* & *Oberdieck* 920 (B); Table Mountain, *Sipman* 20.189 (B); 7–800 m, [on soil] *Werdermann* & *Oberdieck* 49, 51 (B); between Devils Peak and Table Mountain, *Wilms* (B). **Madagascar:** Amboluimiloimbo Forest, *Forsyth Major* 543 (BM). **Réunion:** Piton de la Grand Montée, près des sources Reihlac, *de Sloover* 17.258 (LG). **Sri Lanka:** Horton Plains, World's End, *Bohlin* (S). **Malaysia: Pahang.** Fraser's Hill, *Burkill* 2073 (L); *Dransfield* 514 (BM); Cameron Highlands, *Bowen* 4090 (E). Sabah. Mt Kinabalu, *Samsudin* (UKMB). **Indonesia. Java:** Herb. Lugd. Batav. (L); Mt Ardjunoi, *Groenhart* 1855, 1982 (L); Mt Panderman, *Groenhart* 1954 (L); Mt Lawu, *Clason* 985 (L); Mt Gede, *van Ootstroom* 145900 (L). **Philippines: Luzon.** Benguet, *Merrill* 7952 (BM); Mt Santo Tomas, *Aptroot* 20454, 20450, 20451 (Herb. Aptroot); *Sipman* 21812 (B). **Papua New Guinea: Morobe.** Saruwaged Range, *Sipman* 24330, 24337, 24387 (B); Kaisinik, *Kashiwadani* 10743 (TNS); Wau, Mt Kaindi, *Kashiwadani* 10588, 10593 (TNS); *Streimann* 34024 (CBG); near Honzeukngon village, *Aptroot* 17931–2, 18025 (Herb. Aptroot); Gumi Divide, *Streimann* 22760, 22769 (CBG); Koke Village, *Streimann* & *Tamba* 11730 (CBG); Manki Trig, *Streimann* & *Bellamy* 12969 (CBG). **Eastern Highlands.** Wopeia, *Streimann* 18328a (B); Chimbu. Pindaunde Valley, *Aptroot* 32740 (Herb. Aptroot); *Weber* & *McVean* (COLO); Lake Piunde, *Sipman* 22121 (B); Mt Wilhelm, *Kashiwadani* 10846, 10885, 10998, 11199, 11417 (TNS); *Aptroot* 18243

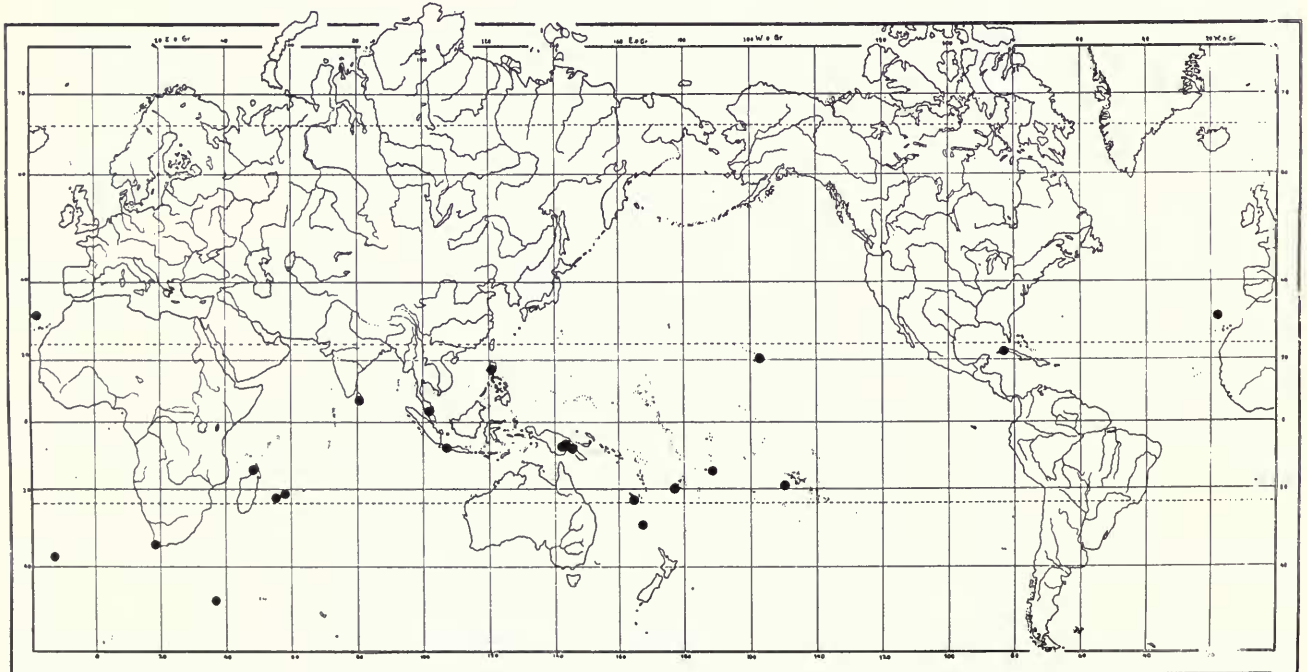


Fig. 19 Distribution of *Pseudocyphellaria intricata* in the palaeotropics.



(Herb. Aptroot); *McVean* 66115 (CBG); Imbuka Ridge above Lake Aunde, *Weber & McVean* (COLO); Yagle Village, *Kawagle* 2 (CBG); Goroka, Daulo Pass, *Aptroot* 31660 (Herb. Aptroot); Mt Gahavisuki Nature Reserve, *Aptroot* 18802, 18842 (Herb. Aptroot); 1500 m, *Streimann & Kairo* 18155 (CBG). **Madang**, Finisterre Range. Teptep Village, *Aptroot* 31931, 32288, 32295 (Herb. Aptroot). **Central**, 2 km N. of Waiotape Airstrip, *Kashiwadani* 11559, 11653, 12244 (TNS); Mt Albert-Edward, *Kashiwadani* 11776 (TNS); Varirata National Park, *Streimann & Vinas* 14472 (CBG). **Southern Highlands**, Iaro River, *Streimann* 23823 (CBG). **Western Highlands**, Kagamuga, *Streimann* 21712 (CBG). **Enga**, Mape Creek, *Streimann* 21569, 22112 (CBG). **New Caledonia**: Tinchialit Camp, *Cheeseman* (BM); sine loco, *Compton* (BM). **Norfolk Island**: Mt Pitt Reserve, Mt Bates, *Streimann* 34386, 34331 (CBG). **Fiji**: sine loco, *Wilson* (MEL). **Samoa**: **Upolu**, *Schultz-Motel* 3496 (B). **Tahiti**: sine loco, *Jelinek* 53 (W). **Hawaiian Islands**: **Oahu**, Koolau Mountains, ridge from Tantalus to Puu Konahuanui, *Smith* 130as (Herb. Smith).

17. *Pseudocypbellaria maculata* D.J. Galloway in *Bull. Br. Mus. nat. Hist. (Bot.)* 17: 187 (1988). Type: New Zealand. South Island, Nelson, Maruia River, Speargrass Flat, near Springs Junction, on twigs of wayside shrubs, 22 September 1981, *D.J. Galloway* (CHR 381022-holotype; BM-isotype).

*Pseudocypbellaria maculata* is a member of the *P. crocata* complex of taxa characterized by a white medulla, a cyanobacterial photobiont and yellow pseudocypbellae on the lower surface. The species is described in detail in Galloway (1988: 187–191) and material examined from New Guinea agrees in all respects with New Zealand collections from which the species was described.

**CHEMISTRY**. Methyl evernate (tr.), tenuiorin, methyl lecanorate (tr.), methyl gyrophorate, evernic acid (tr.), gyrophoric acid (tr.), hopane-6 $\alpha$ , 7 $\beta$ , 22-triol, norstictic (tr.), salazinic, consalazinic, galbinic acids, pulvinic dilactone, pulvinic acid and calycin.

**OBSERVATIONS**. *Pseudocypbellaria maculata* is dark slate-blue to brown black, suffused red-brown when wet, olivaceous-grey to red-brown when dry; it has a white medulla, a cyanobacterial photobiont, a conspicuously faveolate upper surface with a well-defined reticulate pattern of white (photobiont-free) maculae best seen when the thallus is wet ( $\times 10$  lens), and yellow pseudocypbellae on the lower surface and visible at the lobe margins. It lacks isidia, soredia, phyllidia, pseudocypbellae or tomentum on the upper surface. Its loose, straggling habit (especially in alpine grassland habitats where it is often best-developed) is also characteristic. It is rarely fertile. *P. maculata* is distinguished from *P. gilva* by its thinner more fragile and papery thallus, by its markedly faveolate upper surface with characteristic sharp, reticulate ridges, and the pale to buff silkily white-tomentose lower surface; from *P. crocata* by the absence of soredia; from *P. crocatoides* by the lack of marginal proliferations; from *P. desfontainii* by the absence of isidia; and from *P. neglecta* by the absence of phyllidia.

**DISTRIBUTION AND ECOLOGY**. An epiphyte of trees and shrubs in montane rainforest and high alpine grassland habitats of high humidity in New Guinea, 1200–3810 m. Also in

New Zealand where it occurs in rainforest and alpine grassland habitats (Galloway, 1988).

**SPECIMENS EXAMINED**. **Irian Jaya**: Carstenz Mountains, *Hope* (COLO). **Papua New Guinea: Eastern Highlands**, Chimbu, Pindaunde Valley, *Stone* 9903 (Herb. Aptroot); *Weber & McVean* (Herb. Aptroot); *Aptroot* 32732 (Herb. Aptroot); Mt Wilhelm, *Kashiwadani* 11000, 11087, 11128, 11335, 11354 (TNS); *McVean* 66179 (CBG); Goroka, Daulo Pass, *Streimann & Kairo* 18138 (CBG); Mt Gahavisuki Nature Reserve, *Aptroot* 18803 (Herb. Aptroot). **Morobe**, Mt Sarawaket [Saruwaged] Southern Range, *Koponen* 32164, 32640 (Herb. Aptroot); track to Mt Missim, *Bellamy* 211 (CBG); Wau, Mt Kaindi, *Kashiwadani* 10537 (TNS); Mt Missim, *Kashiwadani* 10412 (TNS); Slate Creek and Gumi Creek Divide, *Streimann* 13978 (CBG); Araulu Logging Area, *Streimann* 13619 (CBG). **Central**, 2 km N. of Waiotape Airstrip, *Kashiwadani* 12257 (TNS). **Southern Highlands**, Margarima-Tari Road, *Streimann* 24380 (CBG). **Western Highlands**, Yobobos, *Hoogland & Schodde* 7640 (COLO). **Enga**, Mape Creek, *Streimann* 21540 (CBG).

18. *Pseudocypbellaria multifida* (Nyl.) D.J. Galloway & P. James in *Lichenologist* 12: 301 (1980). *Sticta multifida* Nyl., *Syn. meth. lich.* 1(2): 363 (1860). *Sticta dissecta* Laurer in *Linnaea* 2: 41 (1827), non *S. dissecta* (Sw.) Ach. (*Meth. Lich.*: 279 (1803)). *Crocodia multifida* (Nyl.) Trevis., *Lichenotheca veneta* exs. 75 (1869). *Lobaria multifida* (Nyl.) Hellb. in *Bih. K. svenska VetenskAkad. Handl.* 21(2/13): 38 (1896). Type: Nov. Holland [Australia], *Sieber* 45 (BM-lectotype (Galloway, 1988: 199)). For additional synonymy see Galloway (1988: 199–200).

*Pseudocypbellaria multifida* is a palaeotropical taxon with a highly plastic morphology and having a white medulla and pseudocypbellae, a green algal photobiont and a basic two-hopane chemistry. It is discussed in detail in Galloway (1988: 199–204).

**CHEMISTRY**. 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

**OBSERVATIONS**. *Pseudocypbellaria multifida* is bright lettuce-green when wet, pale greenish grey to buff brownish when dry; it has very variable, rather delicate lobes ranging from  $\pm$  broadly rounded to more usually narrow and highly divided, entangled-imbricate, the margins ragged-incised to lobulate or richly phyllidiate. The upper surface is smooth, undulate or shallowly wrinkled, punctate-impressed, with occasional, white maculae towards margins, and occasionally to densely developed, simple, squamiform, palmate-coralloid to  $\pm$  strap-like phyllidia. It has a white medulla, a green photobiont, and a pale whitish, glabrous, glossy, smooth or shallowly wrinkled lower surface, with a usually poorly developed, thin, short, velvety tomentum centrally, and with scattered, white, fleck-like pseudocypbellae most noticeable at margins. Apothecia are rare. It has a basic two-hopane chemistry. It is distinguished from *P. prolificans* by its plane or undulate, not distinctively punctate-impressed upper surface, by the unthickened,  $\pm$  naked margins of the lower surface and by the frequently  $\pm$  squamiform phyllidia; from *P. insculpta* which has a cyanobacterial photobiont and a punctate-impressed upper surface; and from *P. homalosticta* which has pseudocypbellae on the upper surface which occasionally become  $\pm$  sorediate.

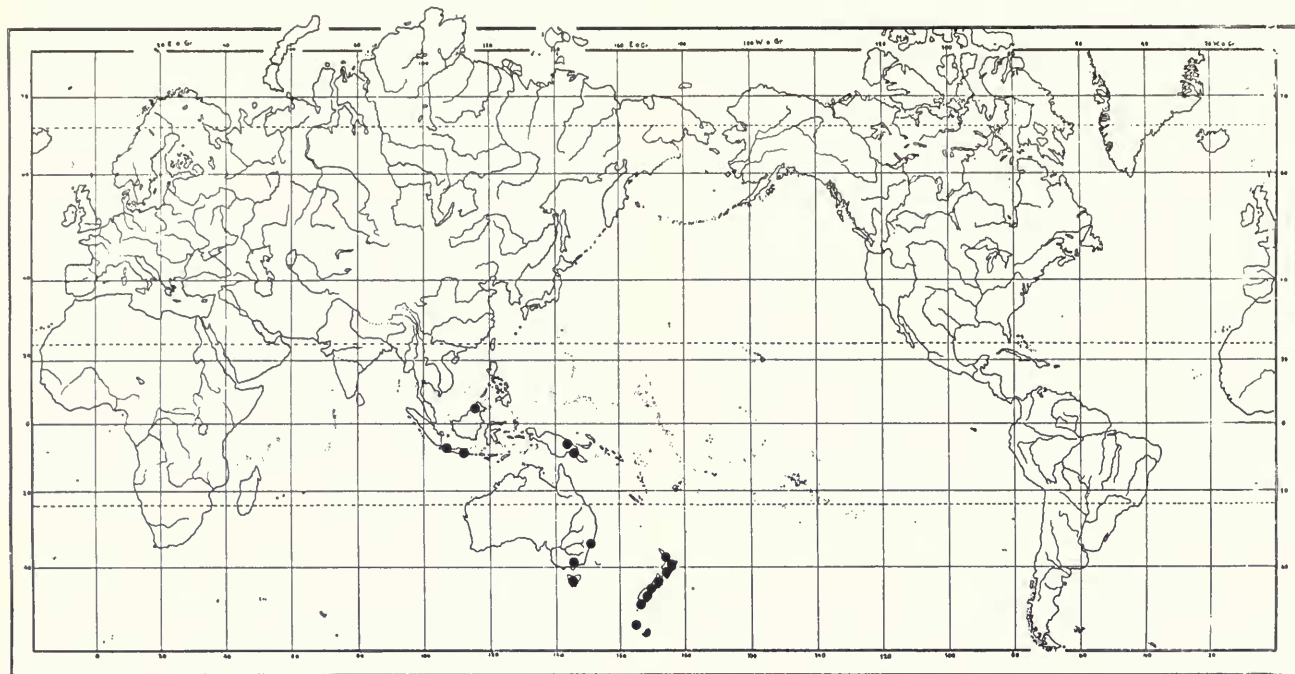


Fig. 20 Distribution of *Pseudocyphellaria multifida* in the palaeotropics.

**DISTRIBUTION AND ECOLOGY.** From Sabah and Java eastwards to New Guinea (Fig. 20) and southwards to Australasia where it is common throughout New Zealand (Galloway, 1988) and in Tasmania (Kantvilas, 1988). In the palaeotropics it is an epiphyte of trees and shrubs and overgrows rotting logs in humid montane rainforest, 1000–2900 m.

**SPECIMENS EXAMINED.** **Malaysia: Sabah.** Mt Kinabalu, *Samsudin* (UKMB). **Indonesia. Java:** East Java. Mt Tengger, *Groenhart* 260, 1835, 7265 (L); Mt Kawi, *Groenhart* 7248, 7249, 7256, 7257, 7258 (L); Mt Ardjuno, *Groenhart* 1534, 1867, 6254 (L); Mt Andjasmoro, *Groenhart* 1817, 1874, 1875, 7230 (L); West Java. Tjibodas, Mt Gede, *van Ootstroom* 14207 (L); *ibid.*, *Groenhart* 1801 (L); Batavia. Mt Pantjar, *Schiffner* 2978 (WU); Preanger, Tjibodas *Schiffner* (WU). **Papua New Guinea: Morobe.** Mt Kaindi, *Streimann & Bellamy* 17670 (CBG); Kauwara River, *Kairo* 671 (CBG); Koke Village, *Streimann & Tamba* 11665 (CBG); Kaurau, *Kairo* 379 (CBG); Spreader Divide, *Streimann & Tamba* 11951 (CBG); Honzeukngon village, *Aptroot* 17861 (Herb. Aptroot). **Eastern Highlands.** Chimbu. Mt Wilhelm, *Kashiwadani* 11190 (TNS); Goroka. Mt Gahavisuki Nature Reserve, *Aptroot* 18778, 18804, 18829 (Herb. Aptroot). **Southern Highlands.** Onim Forestry Station, *Streimann* 24667 (CBG). **Enga.** Mape Creek, *Streimann* 22084 (CBG).

19. *Pseudocyphellaria neglecta* (Müll. Arg.) H. Magn. in *Acta Horti gothoburg.* **14:** 30 (1940). *Stictina neglecta* Müll. Arg. in *Flora, Jena* **70:** 58 (1887). Type: Australia, New England, sine collectoribus nomine (G002121-holotype). For additional synonymy see Galloway (1988: 207; 1992: 183).

*Pseudocyphellaria neglecta* is a characteristic phyllidiolate species in the *P. crocata* complex and is discussed in detail in Galloway (1988: 207–210).

**CHEMISTRY.** Calycin, pulvinic dilactone (tr.), pulvinic acid, tenuiorin, methyl gyrophorate, stictic, constictic, norstictic (tr.), cryptostictic (tr.), salazinic (tr.) acids, 6 $\alpha$ -acetoxyhopane-7 $\beta$ , 22-diol (minor), 7 $\beta$ -acetoxyhopane-6 $\alpha$ , 22-diol (tr.), hopane-6 $\alpha$ , 7 $\beta$ , 22-triol (major), hopane-7 $\beta$ , 22-diol (minor), hopane-15 $\alpha$ , 22-diol (tr.), 7 $\beta$ -acetoxyhopane-22-ol (tr.), 15 $\alpha$ -acetoxyhopane-22-ol (tr.), retigeranic acid (minor) and traces of unidentified triterpenoids.

**OBSERVATIONS.** *Pseudocyphellaria neglecta* is lead-grey to dark blue-black or suffused red-brown when wet, olivaceous-brown, red-brown, brownish yellow or reddish to  $\pm$  blackened in exposed habitats when dry; it has linear-elongate to broadly rounded lobes with entire to crenate-incised to densely phyllidiolate margins. The upper surface is undulate, wrinkled to subfaveolate, occasionally with squamiform phyllidia regenerating from cracks or scattered over upper surface, often eroding apically and appearing sorediate, or breaking off and leaving small yellow scars like pseudocyphellae. It has a white medulla, a cyanobacterial photobiont and yellow pseudocyphellae on the lower surface. It has a complex chemistry containing pigments, depsides, depsidones and hopane-6 $\alpha$ , 7 $\beta$ , 22-triol as the major triterpenoid. For differences between *P. crocata*, *P. crocatoides*, *P. gilva* and *P. dozyana* see above under these taxa.

**DISTRIBUTION AND ECOLOGY.** Widespread in the South Pacific from Mt Kinabalu (Sipman, 1993) eastwards to New Guinea and Tahiti (Fig. 21). It is also known from Australia (where it is extremely common and the most widely collected species), New Zealand (Galloway, 1988) and Chile (Galloway, 1992) where it tends to favour rather dry sites with high light intensities. In the palaeotropics it is found in more humid situations; on roadside banks, on rocks, stumps, fallen branches and rotting logs on the forest floor and as an

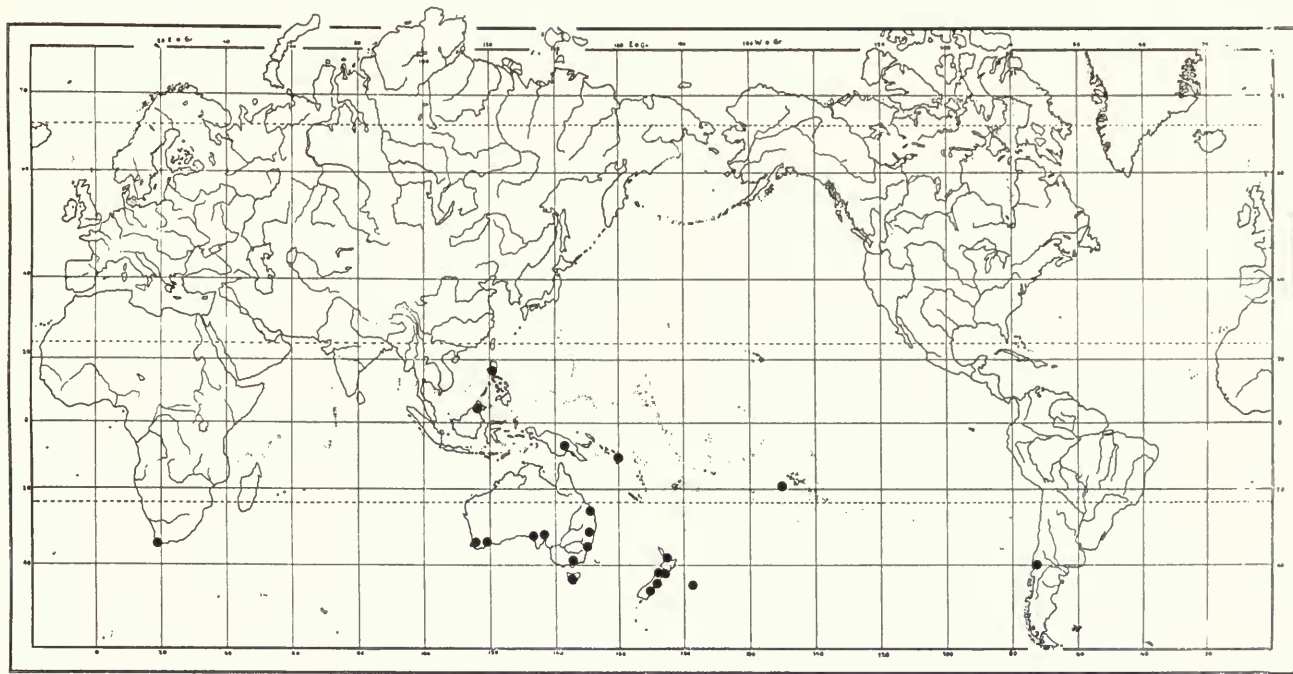


Fig. 21 Distribution of *Pseudocyphellaria neglecta* in the palaeotropics.

epiphyte of trees and shrubs in montane forest and mossy cloudforest, 700–3500 m.

**SPECIMENS EXAMINED.** **Malaysia:** Sabah. Mt Kinabalu, *Sipman & Tan* 30961 (B); *Samsudin* (UKMB). **Indonesia:** Sumatra. Mt Horintji, *Meyer* 7791 (L). **Philippines:** Luzon. Benguet. Mt Santo Tomas, *Sipman* 21750 (B). **Papua New Guinea:** Central. Mt Victoria area, Iswan Swamp, *van Royen* 10957 (Herb. Aptroot). Madang. Finisterre Range, Teptep Village, *Aptroot* 30955 (Herb. Aptroot). Morobe. Mt Kaindi, *Weber & McVean* (Herb. Aptroot, COLO); *Streimann* 19908, 33171, 34072, 34078 (CBG); Herzog Mountains, *Streimann & Umba* 11130 (CBG); Near Honzeukngon village, *Aptroot* 18019 (Herb. Aptroot); Gumi Divide, *Streimann* 25731 (CBG); Aiuwa-Bakia Track, *Streimann & Tamba* 12347 (CBG); Eraulu Logging Area, *Kairo* 338 (CBG); Mt Missim Track, *Streimann* 22923 (CBG). **Eastern Highlands.** Goroka. Daulo Pass, *Weber & McVean* (COLO); Mt Gahavisuki Nature Reserve, *Aptroot* 18806 (Herb. Aptroot); Chimbu. Mt Wilhelm area, *Aptroot* 18321, 18407, 18601, 18654 (Herb. Aptroot). **Southern Highlands.** Onim Forestry station, *Streimann* 24559 (CBG). **Enga.** Mape Creek, *Streimann* 21535, 21554 (CBG). **Solomon Islands:** Guadalcanal Island. Mt Popomansiu, *Hill* 9558 (BM). **Tahiti:** Aorai, *v. Balgooy* 1864a (Herb. Aptroot).

20. *Pseudocyphellaria pickeringii* (Tuck.) D.J. Galloway in *Bull. Br. Mus. nat. Hist. (Bot.)* 17: 218 (1988). *Sticta pickeringii* Tuck., *U.S. Expl. Exped.* 17 (Bot.): 138 (1874). Type: New Zealand, Bay of Islands, Wilkes Expedition, sine collectoribus nomine (FH-holotype).

*Pseudocyphellaria flavicans* auct., non (Hook.f. & Taylor) Vain. For additional synonymy see Galloway (1988: 218–219).

*Pseudocyphellaria pickeringii* is a characteristic yellow-

medulla, isidiate, widespread palaeotropical lichen which is discussed in detail in Galloway (1988: 218–224).

**CHEMISTRY.** Pulvinic acid, pulvinic dilactone, calycin, 2 $\alpha$ , 3 $\beta$ , 22 $\alpha$ -triacetoxystictane, 2 $\alpha$ , 3 $\beta$ -diacetoxystictane-22-ol, stictane-3 $\beta$ -22 $\alpha$ -diol, 2 $\alpha$ -acetoxystictane-3 $\beta$ , 22 $\alpha$ -diol, 3 $\beta$ -acetoxystictane-2 $\alpha$ , 22 $\alpha$ -diol, stictane-2 $\alpha$ , 3 $\beta$ , 22 $\alpha$ -triol, 3 $\beta$ , 22 $\alpha$ -diacetoxystictane, 2 $\alpha$ , 3 $\beta$ -diacetoxystictane-22-ol, 3 $\beta$ -acetoxystictane-22-ol, pseudocyphellarin A, isopseudocyphellarin A, nephroarctin, phenarctin, 2'-O-methylphenarctin, 1'-chlorophenarctin, 2'-O-methylisopseudocyphellarin A, 2'-O-methylpseudocyphellarin A (Elix et al., 1992).

**OBSERVATIONS.** *Pseudocyphellaria pickeringii* is bright lettuce-green suffused golden-yellow when wet, pale lemon-yellow to golden yellow when dry; it is a palaeotropical species forming irregular rosettes on bark, rocks and soil. It has variable,  $\pm$  rounded to complexly divided, rather ragged, incised lobes whose margins are  $\pm$  isidiate-phyllidiate. The upper surface is coriaceous, smooth to faveolate in parts to  $\pm$  scabrid-areolate ( $\times 10$  lens), with marginal and laminal terete isidia and flattened,  $\pm$  dorsiventral phyllidia present. It has a yellow medulla, a green photobiont, and the lower surface is pale yellow to red-brown with a velvety pale tomentum and scattered, yellow, often inapparent pseudocyphellae. Apothecia are sparse or absent, though occasionally frequent in some specimens, sessile to subpedicellate with a conspicuous, whitish buff, coarsely verrucose-scabrid exciple. Spores are colourless, 1–3(–5)-septate, fusiform-ellipsoid, 25–29.5(–32)  $\times$  6.5–7  $\mu$ m. It has a complex chemistry of pigments and stictane triterpenoids (Elix et al., 1992; Wilkins, 1993). It is distinct from *P. aurata* which has characteristic marginal, labriform yellow soralia; from *P. clathrata* which has entire margins without either isidia, phyllidia or soredia; and from *P. poculifera* which has fragile, marginal sorediate isidia.

**DISTRIBUTION AND ECOLOGY.** Widespread in the palaeotro-

pics from the Philippines eastwards to Hawaii and the Marquesas (Fig. 22) and common in the South Pacific in New Zealand (Galloway, 1988) and Australia. On living and dead branches of trees and shrubs (often in canopy branches) in humid montane rainforest and in open habitats of high light, 200–2700 m.

**SPECIMENS EXAMINED.** **Philippines:** Luzon. Benguet, Baguio, *Williams* 1636 (B); Merrill 7953, 7956 (BM); Ramos 13510 (BM); Mt Santo Tomas, *Degelius* as-822 (UPS). **Papua New Guinea:** **Morobe.** Saruwaged Range, *Sipman* 24428 (B); Yinimba, *Streimann* 19025 (CBG); Mt Kaindi, *Kashiwadani* 10524, 10567 (TNS); near Honzeukngon village, *Aptroot* 18021 (Herb. Aptroot); Gumi Divide, *Streimann* 22771 (CBG). **Madang.** Finisterre Range, Teptep Village, *Aptroot* 31938, 32007, 32021, 32293 (Herb. Aptroot). **Eastern Highlands.** Goroka, Daulo Pass, *Streimann* 18020 (CBG); Mt Gahavisuki, *Lambley* 100/84, 102/84 (BM); Kassar Pass, *Streimann & Umba* 11476 (CBG). **Central.** Mt Albert-Edward, *Kashiwadani* 11793 (TNS); Myola, *Lambley* 92/85 (BM). **Western Highlands.** Baiyer-Jimi Divide, *McVean* 68181 (CBG). **New Caledonia:** **Sarramea.** Col d'Amieu, *Hill* 11959, 11982 (BM); sine loco, *Compton* 1300 (BM). **Norfolk Island:** Mt Pitt Reserve, *Streimann* 31931, 31944 (CBG); track from Mt Bates, *Streimann* 34252 (CBG); Selwyn Pine Road, *Hoogland* 6587 (L). **Samoa:** Tutuila, *Lutisa?* (B). **Hawaiian Islands:** **Oahu.** Pauoa, *Heller* (BM, L, US); Waianae Mountains, Mokuleia Forest Reserve, *Smith* 3151 (Herb. Smith); Koolau Mountains, Kahuku Forest Reserve, *Smith* 1660 (Herb. Smith); Honolulu, *Faurie* 441 (BM). **Kauai.** Hanapepe Valley, *Heller* (BM, L); *Faurie* 87 (BM). **Maui.** South slope of Haleakala, Auwahi, *James & Smith* 84/2 (BM); Haleakala, *Faurie* 591, 592 (BM). **Marquesas Islands:** Nukuhiva, *Tovii*, *Peake* (BM).

21. *Pseudocyphellaria poculifera* (Müll. Arg.) D.J. Galloway

& P. James in *Lichenologist* **12**: 301 (1980). *Sticta poculifera* Müll. Arg. in *Flora, Jena* **65**: 304 (1882). Type: Lord Howe Island, Mt Gower, *F. v. Mueller* (G 002123-holotype; BM, MEL-isotypes).

This characteristic rosette-forming to irregularly spreading, yellow-medulla species is described in detail in Galloway (1988: 224–228) and in Elix et al. (1992: 71–72).

**CHEMISTRY.** Pulvinic acid, pulvinic dilactone, calycin, 3 $\beta$ -acetoxyfern-9(11)-en-12-one, fern-9(11)en-3 $\beta$ , 12 $\beta$ -ol, 3 $\beta$ -hydroxyfern-9(11)-en-12-one, 3 $\beta$ -acetoxyfern-9(11)-en-12 $\beta$ -ol, 3 $\beta$ -acetoxyfern-9(11)-en-19 $\beta$ -ol and unidentified triterpenoids (Elix et al., 1992).

**OBSERVATIONS.** *Pseudocyphellaria poculifera* is bright lettuce-green suffused yellow-gold when wet, pale green-grey when dry; it is a palaeotropical species characterized by a yellow medulla, a green photobiont, yellow pseudocyphellae on the lower surface, greenish yellow, mainly marginal (occasionally also laminal), densely clustered, minutely coralloid, rather delicate isidia which are  $\pm$  corticate at first, but soon erode and become sorediate. It is quite commonly fertile, the apothecia being marginal or submarginal and distinctly pedicellate and with granular isidiate margins. Spores are pale to dark red-brown, 3-septate, broadly fusiform-ellipsoid, (18–)20–23(–25)  $\times$  5.5–7.5  $\mu$ m. It has a complex chemistry of pigments and fernene triterpenoids (Elix et al., 1992). It is readily distinguished from the related *P. aurata* which has characteristic linear-labrifiform marginal soralia; and from *P. pickeringii* in the nature of the isidia, the structure of the exciple, the attachment of the apothecia, and in the size and colour of the spores.

**DISTRIBUTION AND ECOLOGY.** A palaeotropical species (Fig. 23) which is known from East Africa (where it is extremely rare) and from Peninsular Malaysia and the Philippines

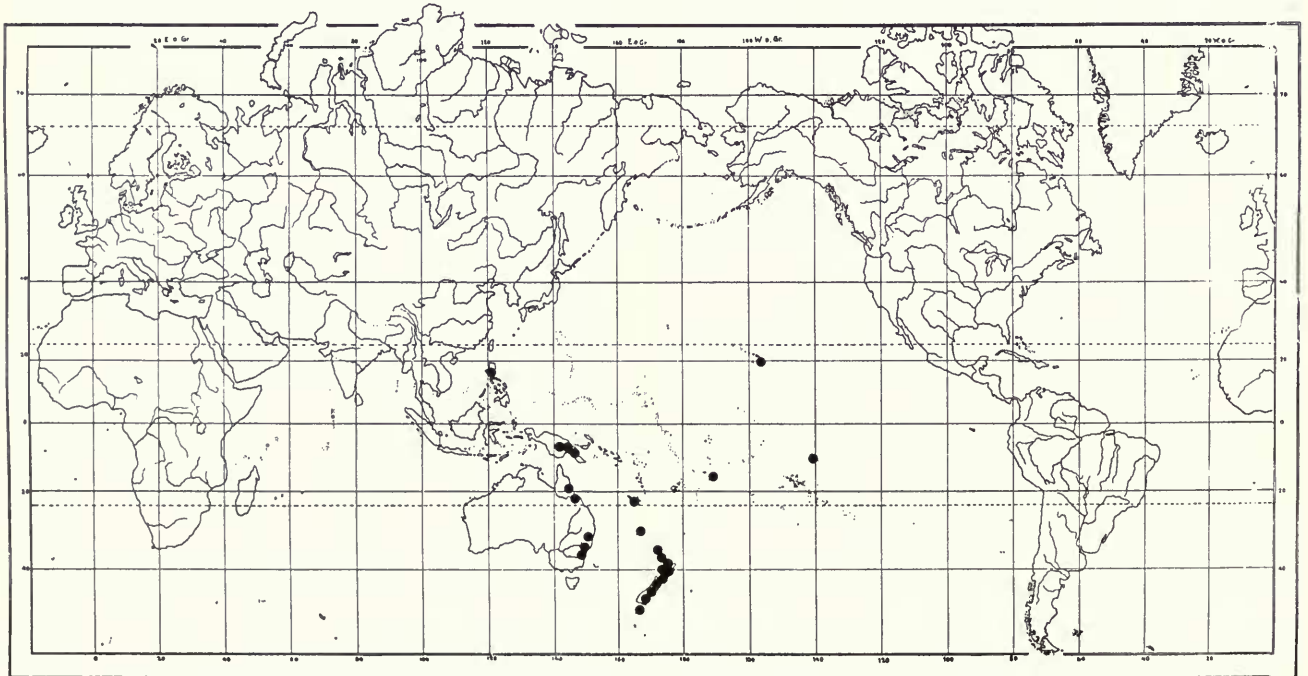


Fig. 22 Distribution of *Pseudocyphellaria pickeringii* in the palaeotropics.

eastwards to Fiji and Norfolk Island where it is common (Elix et al., 1992) and southwards to eastern Australia and northern New Zealand (Galloway, 1988). It occurs on bark and twigs of a variety of phorophytes in open conditions, occasionally on rocks also. It has an altitudinal range from sea level to 750 m throughout most of its range; the sole East African specimen seen was from 2100 m.

**SPECIMENS EXAMINED.** **Africa.** **Uganda:** Butandiga Bugishu, A.S.T. 2555 (BM). **Malaysia:** **Pahang.** Fraser's Hill, Galloway (KEP). **Indonesia.** **Java:** Near Wonosobo, Oka 4087 (L). **Papua New Guinea:** **Morobe.** Kasu Village, Kairo 563, 573 (CBG). **New Caledonia:** **Sarramea.** Col d'Amieu, Hill 11872, 11883 (BM). **Norfolk Island:** Cascade, *Ralston* (BM, COLO); Prince Phillip Drive, *Streimann* 36480 (CBG); Capt. Cook Monument, *Streimann* 32045 (CBG); Mt Pitt Reserve, track to Hollow Pine, *Streimann* 31994 (CBG); Mt Pitt Road, *Streimann* 31943, 31923 (CBG); King Fern Valley, *Streimann* 34552 (CBG); Mt Pitt, *Streimann* 34814 (CBG); track at end of Sellwyn Pine Road, *Streimann* 34648, 34655 (CBG); off Selwyn Pine Road, Filmy Fern Trail, *Streimann* 32106, 32086, 32159 (CBG); Mt Bates, *Streimann* 34228 (CBG); Bird Rock Track, *Streimann* 34899 (CBG); track from Mt Bates, *Streimann* 34300 (CBG); summit of Mt Bates, *Ralston* 90b (BM); east side Mt Bates, *Hoogland* 11.157 (BM); north side Mt Bates, *Green* 1424 (BM); Now-now Valley, *Hoogland* 11.257 (BM); 'High ground', sine loco, *Milne* (BM). **Fiji:** **Viti Levu.** Nandarivatu, *Smith* 5965 (L); sine loco, *Milne* (BM).

22. *Pseudocypbellaria prolificans* (Nyl.) Vain. in *Philipp. J. Sci. sect. C, Bot.* **8:** 117 (1913). *Sticta prolificans* Nyl. in *Annls Sci. Nat. Bot.* **IV,** **15:** 42 (1861). *Crocodia prolificans* (Nyl.) Trevis., *Lichenotheca veneta* exs. 75 (1869). Type: New Caledonia, ad cortices sylvarum in Kanala, *Vieillard* 1795 (PC-holotype).

Fig. 24.

*Pseudocypbellaria multipartita* Vain. in *Philipp. J. Sci. Sect. C, Bot.* **8:** 116 (1913). Type: Philippines, Luzon, Batangas Prov. Ad truncos arborum et supra muscos. November 1907, *H.M. Curran* & *M.L. Merritt* Forest Bureau 7809 (TUR-VAINO 10291-lectotype, selected here).

**Thallus** very variable, orbicular to irregularly spreading, often forming densely entangled clones, 5–12(–18) cm diam., loosely to closely attached centrally, margins and apices free,  $\pm$  ascending. **Lobes** very variable, most commonly rather narrow, linear-laciniate, rather ragged, (1–)2–5(–8) mm wide, 1–4(–8) cm long, to occasionally broadly rounded, 8–15 mm wide, subdichotomously branching at or near apices, complex-imbricate, entangled centrally, apices truncate, rounded or  $\pm$  furcate, divergent. **Margins** entire towards apices becoming densely phyllidiate towards centre, noticeably thickened above and below, pseudocypbellae often prominent on lower margin. **Upper surface** lettuce-green to olive-green when wet, undulate, irregularly to markedly dimpled, punctate-impressed, often with dense to widely scattered papillae (use  $\times 10$  lens), thin and papery to tough, coriaceous, without isidia, maculae, pseudocypbellae or soredia. **Phyllidia** common, conspicuous, mainly marginal but also laminal, occasionally terete at first, soon becoming flattened-dorsiventral, constricted at base, 0.1–0.5 mm wide, 1–5(–10) mm tall, simple, branched to  $\pm$  coralloid, single or densely clustered and proliferating. **Medulla** white. **Photobiont** green. **Lower surface** whitish or pale yellow-brown or pinkish fawn, smooth or wrinkled, glossy at margins to chestnut or red-brown centrally, or uniformly pale from margins to centre, tomentose from margins to centre or only in older parts, tomentum very variable, thick and woolly to thin, ragged and scattered in patches, white, silky, to dark-brown, red-brown or  $\pm$  blackened. **Pseudocypbellae** common, conspicuous, white, round to irregular, 0.1–1.5 mm

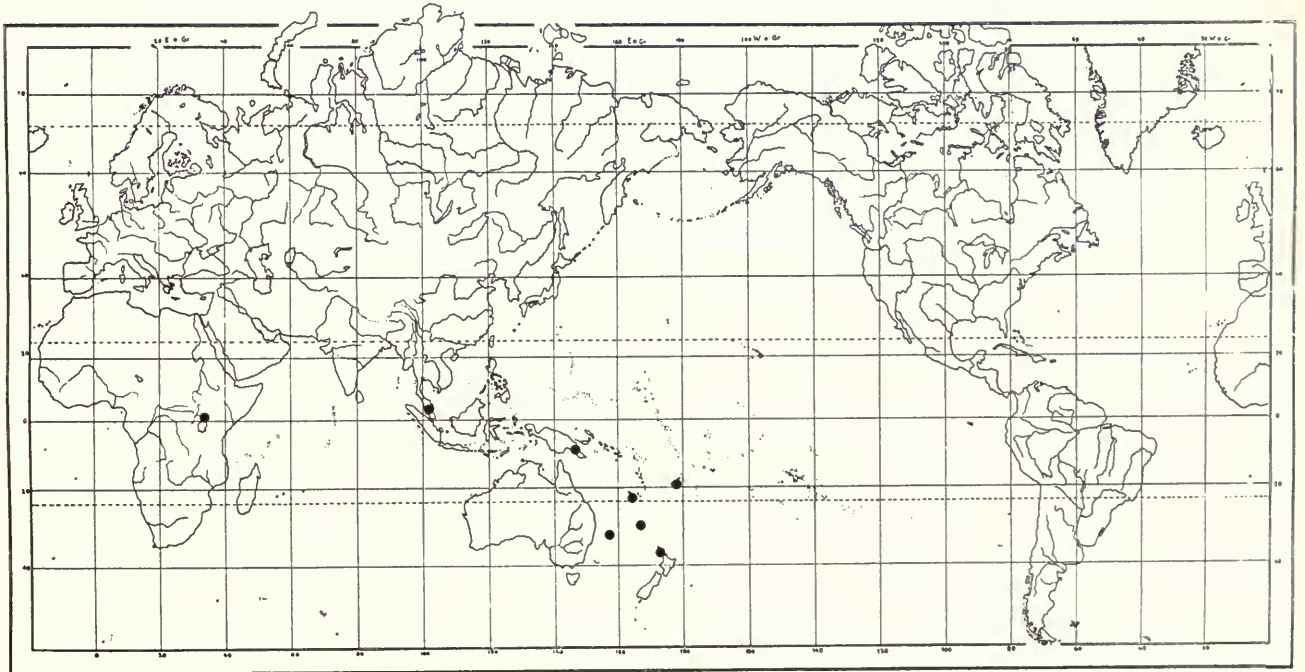


Fig. 23 Distribution of *Pseudocypbellaria poculifera* in the palaeotropics.

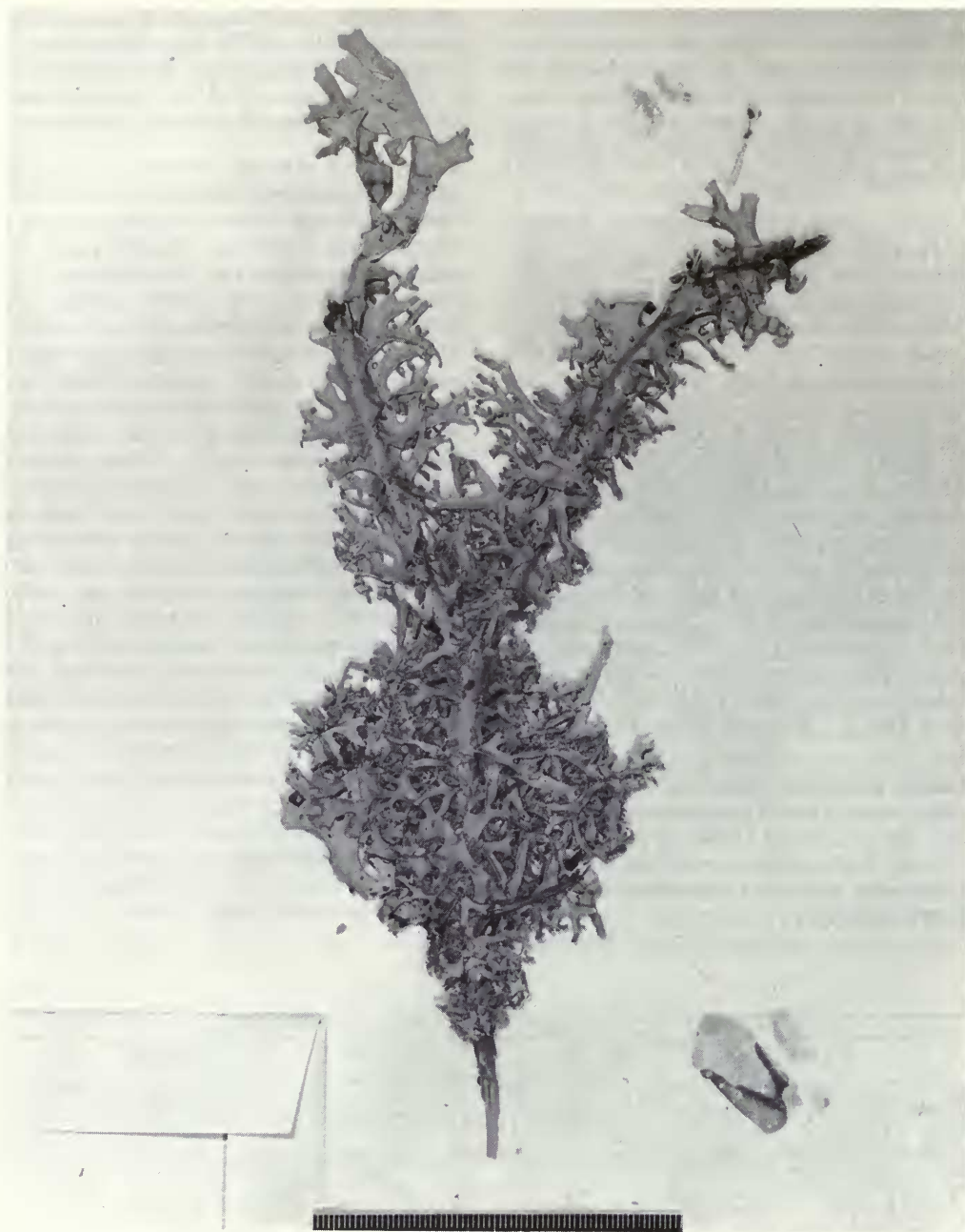


Fig. 24 *Pseudocyphellaria prolificans*. Holotype (PC). Scale in mm.

diam., margins raised, projecting from tomentum, decorticate area flat.

*Pycnidia* common, scattered on upper surface, or concentrated in groups or lines at lobe margins, hemispherical, 0.1 mm diam., ostiole raised, red-brown.

*Apothecia* rather rare, often absent, when present prominent, marginal or submarginal, rounded 2–4(–5.5) mm diam., subpedicellate, pedicel short, 1–1.5 mm wide, pale whitish buff, exciple pale whitish buff to yellow-brown, translucent when wet, massive, corrugate-scabrid, obscuring disc when young, persisting at maturity as a thick, prominent margin, disc  $\pm$  deeply cupuliform at first, subconcave to plane at maturity, smooth, shining, pale to dark chestnut-brown to red-brown, epruinose. *Epithecium* pale yellow-brown, to

14  $\mu$ m thick. *Hymenium* colourless, 110–125  $\mu$ m tall. *Ascospores* yellow-brown, simple to 1-septate, fusiform-ellipsoid, apices rounded or pointed, 28–33.5  $\times$  6.5–8  $\mu$ m.

**CHEMISTRY.** Tenuiorin, methyl gyrophorate, gyrophoric and congyrophoric acids, 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

**OBSERVATIONS.** *Pseudocyphellaria prolificans* is a widespread palaeotropical species having a white medulla; a dimpled, punctate-impressed upper surface, often also conspicuously papillate (use  $\times$  10 lens); conspicuously thickened margins below; scattered to densely clustered and proliferating marginal and laminal phyllidia; a white medulla; a green

photobiont; and a two-hopane chemistry with tenuiorin, and gyrophoric acid and derivatives.

It is distinguished from *P. sulphurea* by the marginal and laminal phyllidia; from *P. insculpta* by the green photobiont; from *P. multifida* by the dimpled, punctate-impressed upper surface, the proliferating phyllidia and thicker margins; and from *P. homalosticta* and *P. reineckeana* in lacking pseudocypHELLARIAE on the upper surface.

**DISTRIBUTION AND ECOLOGY.** Widely distributed in the palaeotropics (Fig. 25) from Sri Lanka eastwards to Fiji and Samoa in the south-western Pacific. Also known from north-eastern Australia. On twigs, branches and trunks of trees and shrubs, and on rotting logs in humid montane rainforest and cloudforest, 500–3600 m.

**SPECIMENS EXAMINED.** **Sri Lanka:** Kandy, *Moon* (BM). **Malaysia:** **Sabah.** Mesilau River, *Hale* 29225 (TNS); Mt Kinabalu, *Samsudin* (UKMB). **Indonesia.** **Sumatra:** Mt Sago near Pajakumbuh, *Meijer B* 8273 (L). **Java:** Tjibodas. Mt Gede, *v. Ooststroom* 14457, 14465, 14597 (Herb. Aptroot); sine loco, *Koernich* s.n. (Herb. Aptroot); Mt Kwai, Mt Panderman, *Groenhart* 2639, 2640 (L); Mt Gegerbentang, [on tree] *Groenhart* 2232 (L); Tjibeureum Falls, *Schiffner* 1575 (L); sine loco, *Junghuhn* (L); Mt Pangerango, *Schiffner* 1155, 2970, 3079 (L, BM, WU); sine loco, *Blume* (L). **Philippines:** **Luzon.** Benguet. Mt Santo Tomas, *Aptroot* 20321, 20392 (Herb. Aptroot). **Mindanao.** Mt Batangan, *Warburg* 14214c (B). **Palawan.** Brookes Point. Mt Mantalin-gahan, *Sipman & Tan* 29978 (B). **Irian Jaya:** *Bamler* s.n. (B); Vogelkop Penin. Nettoti Range. Mt Nettoti, *v. Royen & Sleumer* 7476 (Herb. Aptroot). **Papua New Guinea:** **Eastern Highlands.** Chimbu. Lake Aunde, *v. Balgooy* 316 (Herb. Aptroot); Mt Wilhelm, *Weber & McVean* (Herb. Aptroot); *Aptroot* 31580 (Herb. Aptroot); Bundi Gap, *Aptroot* 32195 (Herb. Aptroot); Kotdame, *Mundua* 214, 220 (CBG); Goroka. Mt Gahavisuki Provincial Park, *Aptroot* 31036

(Herb. Aptroot); track to Mt Michael, *Streimann* 18502, 18541, 18809, 18825 (CBG). **Southern Highlands.** Mt Giluwe, *Lambley* (BM); Onim Forestry Station, *Streimann* 24761 (CBG); Margarima-Tari Road, *Streimann* 24369 (CBG). **Morobe.** Wau, Edy Creek Road, *Sipman* 15619 (Herb. Aptroot); Mt Missim, *Bellamy* 1530 (B); Yinimba, *Streimann* 19135 (CBG); track to Mt Missim, *Bellamy* 202, 202a (CBG); *Streimann* 18772 (CBG); Ekuti Divide, *Rau* 702 (CBG); *Streimann* 20126, 20136 (CBG); Mt Kauwara, *Kairo* 687–8 (CBG); Kaisinik, *Kashiwadani* 10739 (TNS); Araulu Logging Area, *Streimann* 13552 (CBG); Slate Creek & Gumi Creek Divide, *Streimann* 13868 (CBG); Wagau-Mulolo Track, *Streimann* 19615 (CBG); Spreader Divide, *Streimann* 11841, 11900 (CBG); Bulolo-Watutu Divide, *Streimann* 25033 (CBG); Honzeukngon village, *Aptroot* 18024 (Herb. Aptroot). **Milne Bay.** Mt Moiba, *Pullen* 7744 (Herb. Aptroot). **Madang.** Finisterre Range, Teptep Village, *Aptroot* 31959, 31997 (Herb. Aptroot). **Central.** Near Myola, *Lambley* (BM); Mt Albert-Edward, *Kashiwadani* 11523, 11723, 11821, 12011 (TNS); 2 km N. of Waiotape Airstrip, *Kashiwadani* 12100 (TNS). **Western Highlands.** Milep Area, *Vinas* 7647 (CBG). **Solomon Islands:** **Guadalcanal Island.** Mt Popomansiu, *Hill* 9283, 9288, 9513, 9561, 9670, 9687, 9709, 9827, 9841, 9856 (BM); Mt Gallego, *Hill* 8173, 8363 (BM); southern slopes of Mt Makarakomburu, *Glenny* 2048, 2055, 2125 (BSIP). **Kolombangara Island.** Ridge west of Kolombangara River, *Hill* 10544, 10573 (BM). **New Caledonia:** [ISOLECTOTYPE] sine loco, *Vieillard* 1795 (B); Rivière Blanche, *Hill* 11696 (BM). **Kermadecs:** [Raoul] **Sunday Island.** Sine loco, *Milne* (NY). **Fiji:** **Viti Levu.** Sine loco, *Degener* (GZU); ridge between Mt Nanggaranambuluta [Lomalangi] and Mt Namama, *Smith* 5004 (BM, L, US); western slopes of Mt Nanggaranambuluta, east of Nandari-vatu, *Smith* 4818 (US); Mt Evans Range, *Smith* 4280 (BM, US); Mt Victoria, *Green* (BM); *Lam* 6823 (L). **Ngau.** Herald Bay, *Smith* 7828 (US). **Ovalu.** Sine loco, *Gräffe* (W). **Samoa:**

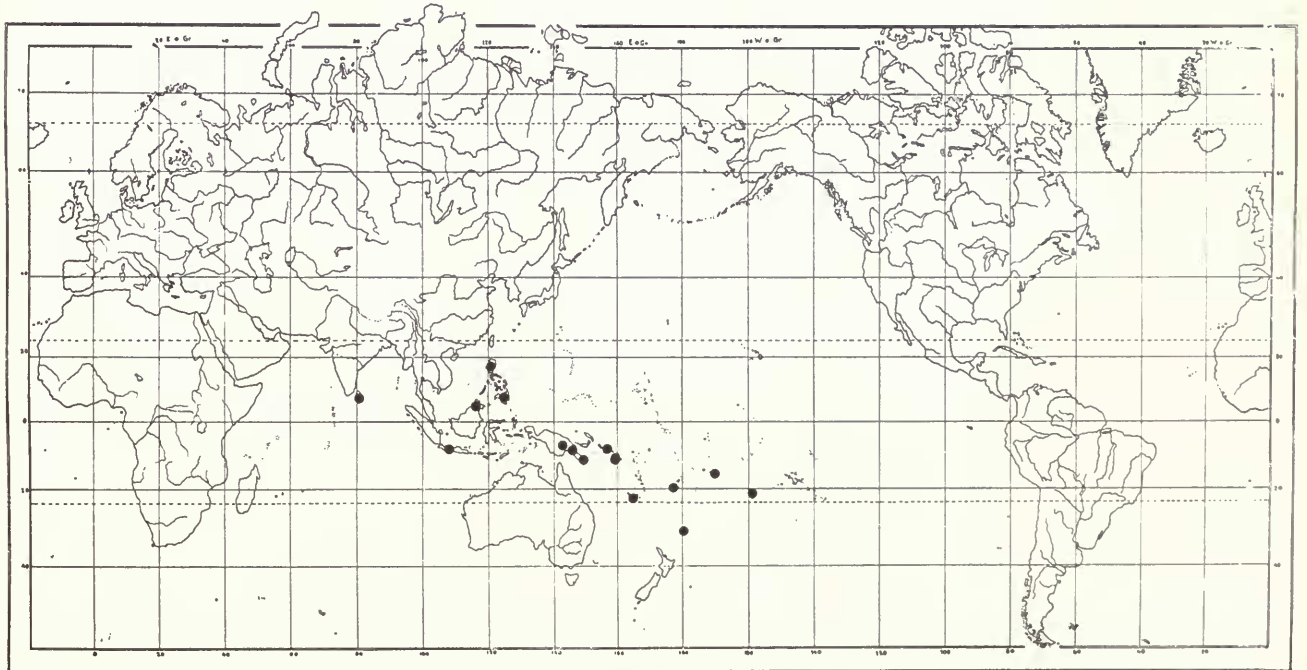


Fig. 25 Distribution of *PseudocypHELLARIA prolifcans* in the palaeotropics.

**Upolu.** See Lanonmea, *Hochsentsimer?* (B). **Rarotonga:** Connells Gully, Parks 22171 (COLO).

23. ***Pseudocyphellaria punctillaris*** (Müll. Arg.) D.J. Galloway in *Graphis Scr.* 5: 9 (1993). *Stictina punctillaris* Müll. Arg. in *Hedwigia* 30: 48 (1891). *Stictina fragillima* f. *punctillaris* (Müll. Arg.) Stizenb. in *Flora, Jena* 81: 129 (1895). *Sticta fragillima* f. *punctillaris* (Müll. Arg.) Zahlbr., *Cat. lich. univ.* 3: 382 (1925). Type: Australia. Queensland, near Mt Bellenden Ker, 'Whelman Pools. Austral. orient', 1889, F.M. Bailey 567 (G 002544-holotype).

Fig. 26.

*Thallus* rosette-forming, 5–10(–15) cm diam., closely attached from margins to centre. *Lobes* broadly rounded, 5–8(–12) mm wide, contiguous or imbricate at margins, crowded-imbricate centrally. *Margins* entire, sinuous, broadly rounded at apices, becoming markedly lobulate-phyllidiate centrally, thickened and sometimes inrolled below. *Upper surface* dark malachite green to glaucous-blue when wet, pale yellowish fawn to brownish or pale red-brown, darker at apices when dry, undulate to wrinkled,

conspicuously verrucose-scabrid (use  $\times 10$  lens), thick, coriaceous, without isidia, maculae or soredia. *Phyllidia* marginal, rarely regenerating from cracks on upper surface, 0.2–1.5 mm diam., lobulate, distinctly jointed at base, simple to subcoralloid. *Pseudocyphellae* white, numerous, often crowded, conspicuous, 0.1–0.5 mm diam., round to elongate, conical-verruciform, margins raised, decorticate area flat. *Medulla* white. *Photobiont* cyanobacterial. *Lower surface* pale yellowish white to buff at margins, cinnamon-brown to red-brown centrally, uniformly tomentose from margins to centre, tomentum thick, woolly, pale at margins, brownish or greyish centrally, often obscuring pseudocyphellae. *Pseudocyphellae* white, scattered, round to irregular, 0.1–1 mm diam., most noticeable at margins, decorticate area flat or concave, granular, margins not raised.

*Pyrenidia* common, prominent, swollen, solitary or crowded, marginal and laminal 0.2–1 mm diam., ostiole punctate, red-brown.

*Apothecia* sparse to frequent, submarginal and laminal, central rarely at lobe apices, sessile, constricted at base, round to deformed through mutual pressure, 1–3 mm diam., shallowly concave to plane, exciple prominent, coarsely

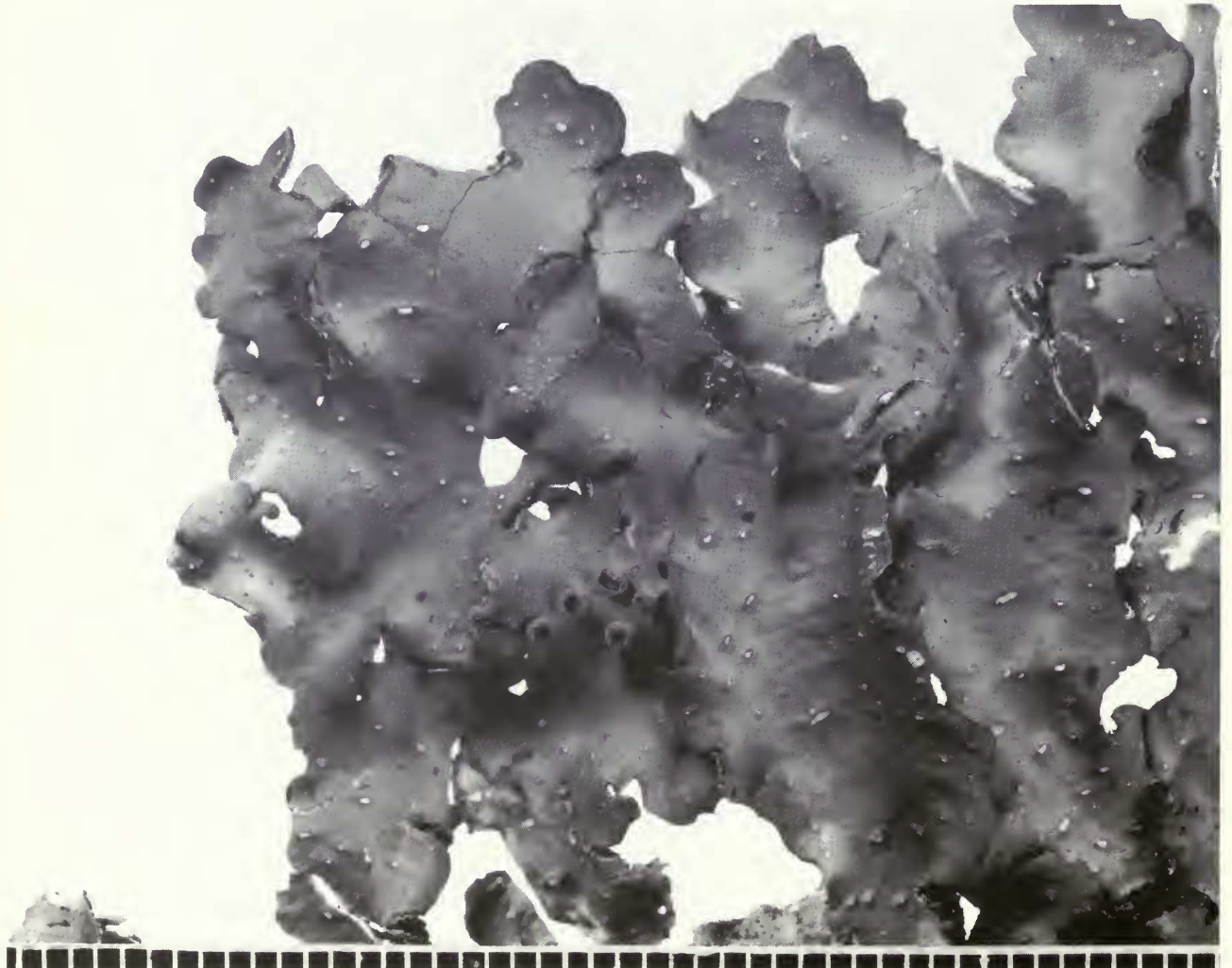


Fig. 26 *Pseudocyphellaria punctillaris*. J.K. Bartlett 32147 (AK, BM). Scale in mm.



verrucose-scabrid, obscuring disc when young, persisting as a coarse, dentate-verrucose margin to disc at maturity, pale brownish, disc shining, slightly roughened, pale to dark red-brown, epruinose. *Epithecium* red-brown, 8–14  $\mu\text{m}$  thick. *Hymenium* colourless, 110–115  $\mu\text{m}$  tall. *Ascospores* 1-septate, contents vacuolate, pale red-brown or yellow-brown, broad-ellipsoid, apices pointed or rounded, 25–28  $\times$  8.5–11  $\mu\text{m}$ .

**CHEMISTRY.** Tenuiorin, methyl gyrophorate, gyrophoric acid, 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

**OBSERVATIONS.** *P. punctillaris* has rather shortly  $\pm$  subdichotomously branching lobes with a white medulla, a scabrid-areolate upper surface, a cyanobacterial photobiont and white pseudocypHELLAE on both upper and lower surfaces. It has a simple two-hopane chemistry with tenuiorin and gyrophoric acid present as accessories. Known from eastern Australia and the Philippines (Galloway & Kemp, 1993). It is distinguished from *P. godeffroyii* by the marginal lobulate phyllidia; and from *P. rigida* (which has a scrobiculate upper surface), *P. semilanata* and *P. trichophora* by its scabrid-areolate upper surface and marginal phyllidia.

**DISTRIBUTION AND ECOLOGY.** A characteristic Pacific species (Fig. 27) known from Indonesia and New Guinea where it seems to be most commonly collected, also from the Philippines, Samoa and in eastern Australia (Galloway & Kemp, 1993), and a single record from Hawaii. It is an epiphyte of rainforest trees and shrubs with an altitudinal range of 100 to 3650 m. Still rather poorly collected in the region.

**SPECIMENS EXAMINED.** **Indonesia. Java:** sine loco, sine coll. (L). **Philippines: Luzon.** Mt Makiling, *Degelius* As-704, As-706 (UPS). **Papua New Guinea: Eastern Highlands.** Chimbu. Pindaunde Valley, *Weber & McVean* (Herb.

Aptroot); Felsspitze, *Ledermann* (B); Mt Wilhelm, *McVean* 66179 (CBG); top of Kassam Pass, *Streimann* 17915 (CBG). **Morobe.** Ekuti Divide, *Streimann* 22615 (CBG). **Milne Bay.** Woodlark Island, *Kumei* 34, 41, 95 (CBG); *Soma* 3 (CBG). **Samoa: Savai.** Lake Mafane, *Bartlett* 32147 (AK, BM). **Hawaiian Islands: Hawaii.** Waimea, *Rock* [Sandwicensens No. 6] (B).

24. *PseudocypHELLARIA reineckeana* (Müll. Arg.) D.J. Galloway in *Lichenologist* 17: 305 (1985). *Stictina reineckeana* Müll. Arg. in Reinecke, *Bot. Jb.* 23: 295 (1896). *Sticta reineckeana* (Müll. Arg.) Zahlbr. in Rech., *Denkschr. Akad. Wiss. Wien* 81: 262 (1907). Type: Samoa, sine loco, 1895, Reinecke (G 002145-lectotype (Galloway, 1985: 305)).

Fig. 28.

*Thallus* irregularly spreading, 2–4(–8) cm diam., loosely attached centrally, margins  $\pm$  free. *Lobes* narrow to medium, (1–)2–4(–8) mm wide, 5–15(–25) mm long, dichotomously to irregularly branching, divergent, discrete at apices, complex-imbriate centrally, apices pointed or smoothly rounded. *Margins* entire, only very slightly thickened below. *Upper surface* bright lettuce green or olive-green suffused brownish when wet, pale glaucous-green to pale buff to dark green-brown when dry, undulate, smooth, to irregularly wrinkled, not faveolate or punctate-impressed, matt or shining, rather brittle, friable when dry, without isidia, maculae, phyllidia or soredia. *PseudocypHELLAE* white, scattered, rather sparse, minute, 0.1 mm diam. or less, fleck-like, punctiform, margins not noticeably raised. *Medulla* white. *Photobiont* green. *Lower surface* pale whitish buff to brownish, darkening centrally, smooth or shallowly wrinkled, glossy at margins, thinly to thickly tomentose centrally, tomentum ragged, whitish to pale buff, often inapparent, to thick, black or brown-black, woolly-entangled and obscuring lower surface

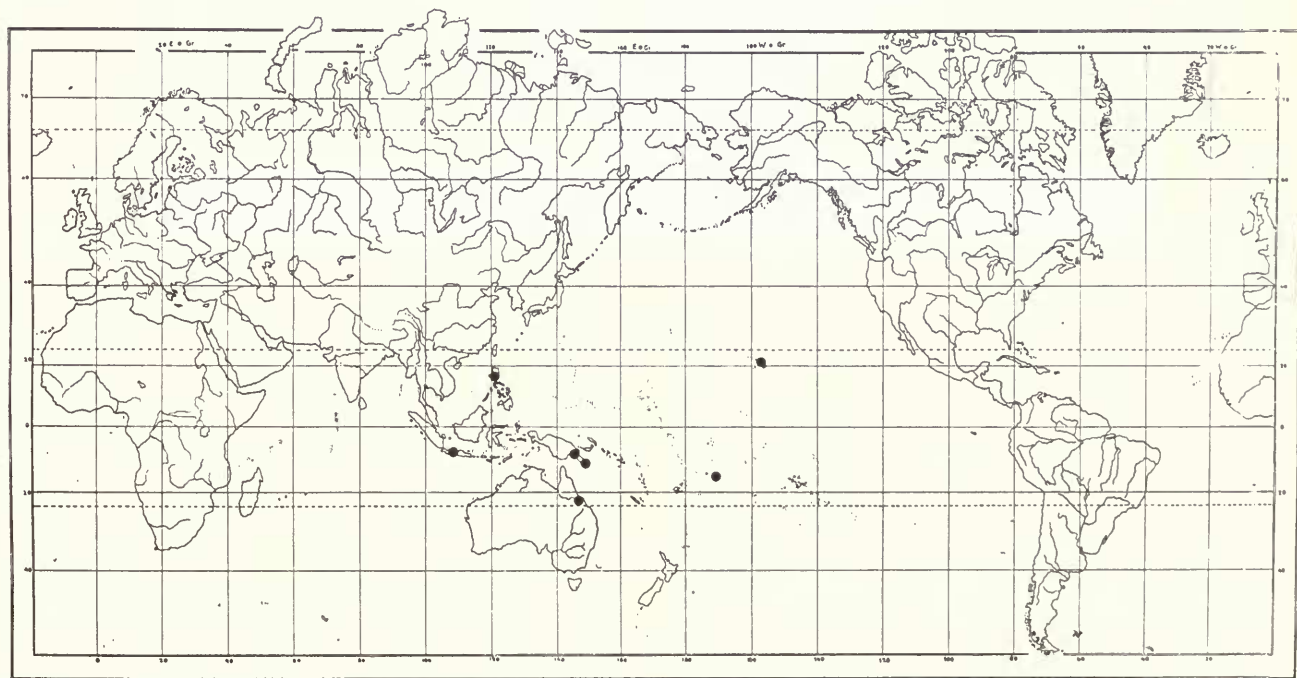


Fig. 27 Distribution of *PseudocypHELLARIA punctillaris* in the palaeotropics.



Fig. 28 *Pseudocyphellaria reineckeana*. Lectotype *Sticta reineckeana* (G 002145). Scale in mm.

and pseudocyphellae. *Pseudocyphellae* white, minute, fleck-like, 0.1 mm diam. or less, widely scattered, margins not noticeably raised.

*Pycnidia* marginal, in groups or lines, minute, punctiform, 0.1 mm diam. or less, ostiole brown-black.

*Apothecia* rare (often absent) to occasional, marginal or submarginal, sessile, constricted at base, rounded, 0.2–2 mm diam., exciple prominent, coarsely verrucose-scabrid, obscuring disc when young, persisting as verrucose-areolate margin at maturity, pinkish brown, translucent when wet, disc orange to red-brown, shining, epruinose. *Epilecium* pale yellow-brown, 5.5–9  $\mu\text{m}$  thick. *Hymenium* colourless to pale straw, 85–100  $\mu\text{m}$  tall. *Ascospores* 1-septate, yellow-brown to

red-brown, contents vacuolate, ellipsoid, apices rounded or pointed, 25–31  $\times$  8.5–11.5  $\mu\text{m}$ .

**CHEMISTRY.** Methyl gyrophorate, gyrophoric acid (+ to ++), 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

**OBSERVATIONS.** *Pseudocyphellaria reineckeana* is characterized by rather narrow lobes, a white medulla, a green photobiont, white fleck-like pseudocyphellae on both upper and lower surfaces and rather variable tomentum on the lower surface which varies from thin and scattered or inapparent, to thick and dark and woolly, obscuring the lower

surface. It has a basic two-hopane chemistry with variable amounts of gyrophoric acid which give a characteristic C+ red medullary reaction. It is similar to *P. homalosticta* but lacks the isidia characteristic of that species; it is distinguished from several taxa which have green photobionts and a two-hopane chemistry, from *P. sulphurea* and *P. stenophylla* by lacking a punctate-impressed upper surface and having pseudocyphellae on the upper surface; from *P. homalosticta* in lacking isidia and from *P. prolificans* and *P. multifida* in lacking marginal and laminal lobules or phyllidia.

**DISTRIBUTION AND ECOLOGY.** An epiphyte of trees and shrubs in montane rainforest, 1000–3500 m. Apparently restricted to the south-west Pacific from Borneo to Samoa (Fig. 29).

**SPECIMENS EXAMINED.** **Malaysia:** Sabah. Mt Kinabalu, *Samsudin* (UKMB). **Kalimantan.** Sine loco, *Lobb* (BM). **Papua New Guinea: Southern Highlands.** Lai River, *Streimann* 22226 (CBG). **Solomon Islands: Guadalcanal Island.** Mt Popomansiu, *Hill* 9717 (BM). **Fiji: Viti Levu.** Suva, *Wilson* (MEL); Mt Nangaranamuluta [Lomalangi], *Smith* 4833 (US); Mt Victoria, *Green* (BM); Nandarivatu, *Green* (BM); sine loco, *Seeman* (BM). **Vanua Levu.** Mt Kasi, *Smith* 1812 (BM). **Samoa: Savai'i.** *Reinecke* 52a (B).

25. *Pseudocyphellaria rigida* (Müll. Arg.) D.J. Galloway in *Lichenologist* 17: 305 (1985). *Stictina rigida* Müll. Arg. in *Bull. Herb. Boissier* 4: 89 (1896). *Sticta rigida* (Müll. Arg.) Zahlbr., *Cat. lich. univ.* 3: 398 (1925). Type: Australia. Queensland, sine loco, *F.M. Bailey* (G 001990-holotype). Fig. 30.

**Thallus** rosette-forming to irregularly spreading 5–10(–15) cm diam., loosely to closely attached centrally, margins free. **Lobes** subdichotomously to irregularly branching, 5–10(–15) mm wide, 0.5–3(–6) cm long. **Margins** entire,

sinuous, markedly thickened-ridged below with prominent, projecting white pseudocyphellae. **Upper surface** dark navy blue to glaucous blue-grey when wet, pale glaucous grey or grey-brown when dry, undulate, irregularly wrinkled to shallowly faveolate, interconnecting ridges smoothly rounded, sometimes indistinct, faveolae shallow, rather papery when dry, flabby when wet, without isidia, phyllidia or soredia. **Maculae** white, minute, ± reticulate, best seen when wet at lobe apices (use × 10 lens), more extensive whitish or buff cyanobiont-free areas often seen. **Pseudocyphellae** scattered, on laminal ridges, rather sparse, white, 0.1 mm diam., margins slightly raised. **Medulla** white. **Photobiont** cyanobacterial. **Lower surface** pale whitish buff or ± greyish at margins, slightly darkening centrally, wrinkled-bullate, sparsely tomentose centrally with prominent glabrous margins or tomentose from margins to centre, tomentum dark brown, woolly, entangled. **Pseudocyphellae** scattered, minute, white, rather sparse at margins, prominent centrally, markedly conical-verrucose, margins prominent, swollen, concolorous with lower cortex, 0.5–1 mm diam., projecting above tomentum.

*Pycnidia* not seen.

**Apothecia** marginal and laminal, rather sparsely developed in older parts of thallus, sessile to subpedicellate, strongly constricted at base, rounded, 0.5–2.5(–3) mm diam., shallowly concave to plane, ± undulate at maturity, exciple coarsely corrugate-scabrid, pale buff or brown, ± translucent when wet, obscuring disc at first, persisting as a ± thick verrucose-scabrid-dentate margin or sometimes ± occluded by disc, disc pale orange-brown to red-brown, shining when young, matt at maturity, smooth, epruinose. **Epithecium** pale yellow-brown, to 14 µm thick. **Hymenium** colourless, 85–100 µm tall. **Ascospores** pale yellow-brown to red-brown, 1–3-septate, contents often vacuolate, ellipsoid, apices rounded or pointed, (25–)28–30.5(–33.5) × 8.5–11 µm.

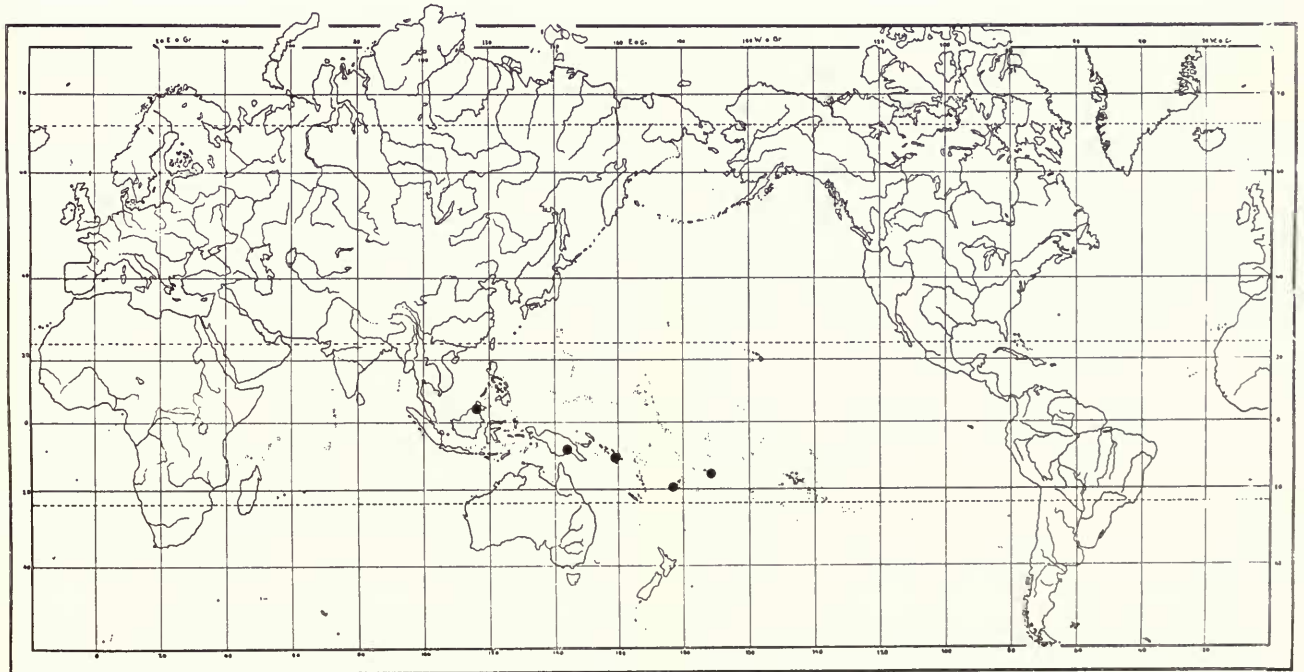


Fig. 29 Distribution of *Pseudocyphellaria reineckeana*.

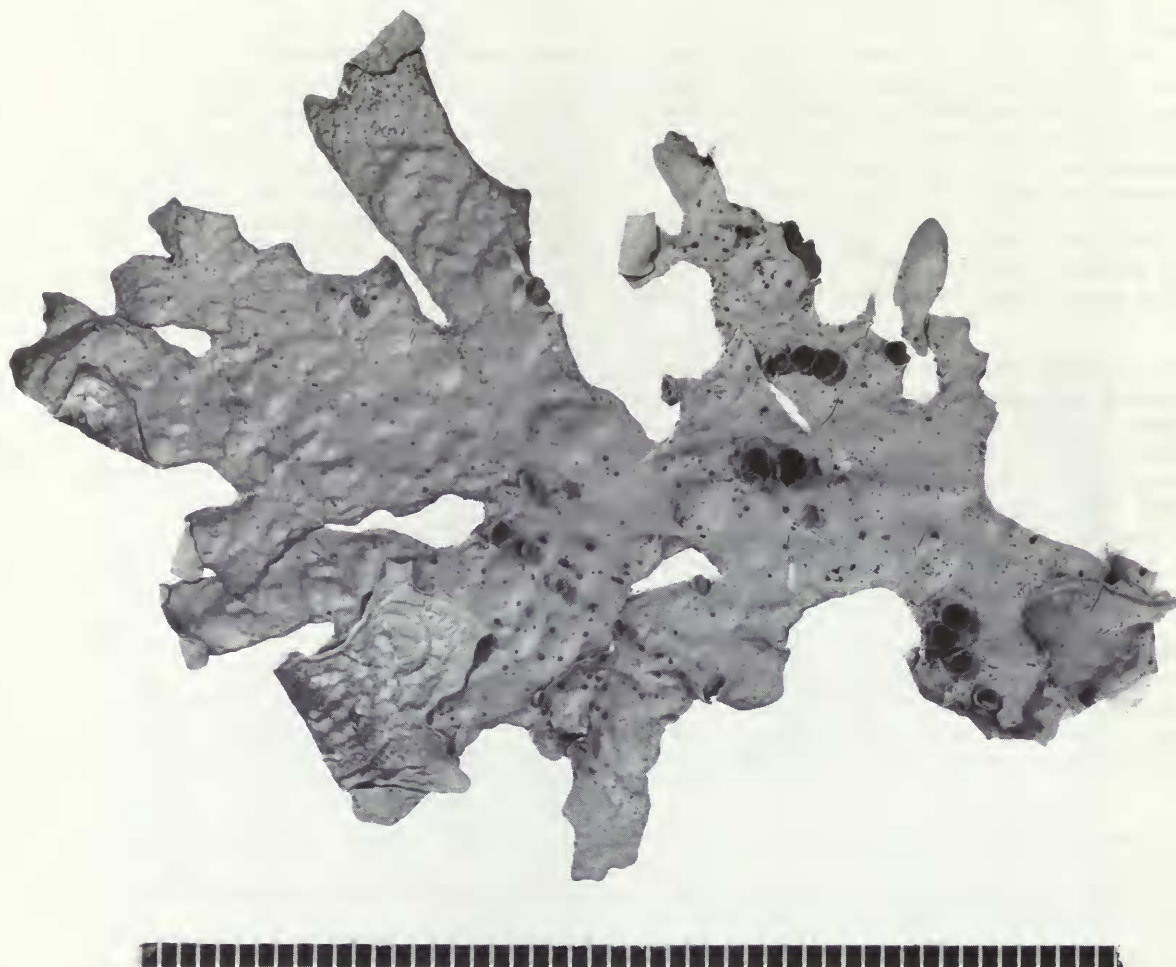


Fig. 30 *Pseudocyphellaria rigida*. H. Kashiwadani 10920 (TNS). Scale in mm.

CHEMISTRY. 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

OBSERVATIONS. *Pseudocyphellaria rigida* is a palaeotropical species characterized by a white medulla, a cyanobacterial photobiont, white pseudocyphellae on both upper and lower surfaces, a scrobiculate-faveolate to punctate-impressed upper surface and a bullate lower surface with continuous to sparse dark tomentum. It has a basic two-hopane chemistry. The distinctive scrobiculate upper surface and rather irregular lobes distinguish *P. rigida* from *P. trichophora* which has a smooth upper surface and hairy lobe margins, and from *P. semilanata* which has a punctate-impressed upper surface and  $\pm$  dichotomously branching lobes.

DISTRIBUTION AND ECOLOGY. To date known in the region only from Mt Wilhelm in Papua New Guinea, on tree bark, 3400–3650 m. Known also from north-eastern Australia.

SPECIMENS EXAMINED. **Papua New Guinea: Western Highlands.** Mt Wilhelm en route from Kombugomanbuno to the Pindaude Lakes, Kashiwadani 10920, 10929 (TNS); van Balgooy 593 (Herb. Aptroot).

26. *Pseudocyphellaria semilanata* (Müll. Arg.) D.J. Galloway in *Lichenologist* 17: 306 (1985). *Stictina semilanata* Müll. Arg. in *Bot. Jb.* 23: 293 (1897). *Sticta semilanata* (Müll. Arg.) Zahlbr., *Cat. lich. univ.* 3: 398 (1925). *Cyanisticta semilanata* (Müll. Arg.) Szatala in *Annls hist.-nat. Mus. natn. hung.* 7: 41 (1956), comb. inval. Type: Ins. Samoa, Dr Reinecke (G 002164-holotype).

Fig. 31.

*Cyanisticta semilanata* var. *epunctulata* Szatala in *Annls hist.-nat. Mus. natn. hung.* 7: 41 (1956). Type: New Guinea, in m. Sattelberg, K. Weinland (B-holotype).

*Pseudocyphellaria argyracea* var. *reveniensi* Vain. in *Hedwigia* 38: 121 (1913). Type: Philippines, Luzon, Sorsogon, Albay, June 1908, H.M. Curran (TUR-V 10134-holotype).

*Thallus* irregularly spreading, 8–12(–15) cm diam., loosely attached centrally, apices  $\pm$  ascending. *Lobes* very variable, 4–10 mm wide, 1–4(–6) cm long, dichotomously branching, apices divergent, furcate, pointed or rounded, discrete from margins to centre or complex-imbricate centrally, flat to  $\pm$  canaliculate. *Margins* entire, distinctly ridged above and



Fig. 31 *Pseudocyphellaria semilanata*. L. Brako 4256 (NY). Scale in mm.

below with often prominent tomentum from lower surface projecting at right angles. *Upper surface* dull slate-blue to glaucous green suffused red-brown in parts especially at margins and apices, pale olivaceous to brownish when dry, undulate, shallowly ridged to distinctly punctate-impressed, rigid, rather coriaceous when dry, pliable when wet, without isidia, phyllidia or soredia. *Maculae* minute, white, imparting a delicate marbling to upper surface (use  $\times 10$  lens), prominent, larger and  $\pm$  reticulate at lobe apices. *Pseudocyphellae* white, scattered, minute, punctiform, 0.1–0.2 mm diam. *Medulla* white. *Photobiont* cyanobacterial. *Lower surface* yellowish white or pale buff at margins, darkening to red-brown centrally, tomentose from margins to centre, tomentum very thick, entangled, woolly, whitish to red-brown or  $\pm$  blackened. *Pseudocyphellae* white, prominent, scattered, round to irregular, 0.2–2 mm diam., margins swollen, prominent, concolorous with lower cortex, often sunk in tomentum.

*Pycnidia* marginal, hemispherical, 0.1 mm diam., solitary or in groups, ostiole dark red-brown or blackened.

*Apothecia* marginal or submarginal, rarely laminal, rare (often absent) to occasional, sessile, constricted at base,

rounded, 0.5–2 mm diam., subconcave to plane, exciple prominent in young fruits, persistent to occluded at maturity, slightly roughened to coarsely scabrid-verrucose, pale brownish, translucent when wet, disc pale to dark red-brown, smooth, epruinose, sometimes with a small central thalline lobule of sterile tissue. *Epithecium* pale red-brown, 8.5–14  $\mu\text{m}$  thick. *Hymenium* colourless, 70–85  $\mu\text{m}$  tall. *Ascospores* pale yellow-brown to red-brown, 1–3-septate, fusiform-ellipsoid, (25–)30.5–33(–36)  $\times$  5.5–8  $\mu\text{m}$ .

**CHEMISTRY.** Methyl gyrophorate ( $\pm$ ), gyrophoric acid ( $\pm$  to ++), 7 $\beta$ -acetoxyhopane-22-ol, hopane-7 $\beta$ , 22-diol (tr.), hopane-15 $\alpha$ , 22-diol.

**OBSERVATIONS.** *Pseudocyphellaria semilanata* is characterized by dichotomously branching lobes, a cyanobacterial photobiont, a white medulla, scattered white pseudocyphellae on both upper and lower surfaces, a punctate-impressed upper surface and a two-hopane chemistry. It is similar to *P. beccarii* but is distinguished from it by having punctiform white pseudocyphellae on the upper surface. It differs from *P. godeffroyii* in having a shining, dimpled upper surface

which is never scabrid-areolate.

**DISTRIBUTION AND ECOLOGY.** A palaeotropical species occurring in the Pacific from the Bonin Islands and Indonesia eastwards to Fiji and Samoa (Fig. 32). Epiphytic on trees and shrubs, on rotting logs and on litter in upper montane and cloud forest, and on small cut trees and fence posts; 100–3650 m.

**SPECIMENS EXAMINED.** **Bonin Islands:** sine loco, *Wright* (US). **Indonesia. Java:** *Laurer* s.n. (B); Mt Lawu, *Feekes* 4969 (L); Mt Kawi, *Groenhart* 1828 (L); Mt Ardjuno, *Groenhart* 1517, 7244, 7246, 7247 (L). **Flores:** sine loco, *Verheijen* 5202 (Herb. Aptroot). **Irian Jaya:** sine loco, *Bamler* (B); Biri, *Weinland* (B). **Papua New Guinea: Madang.** Finisterre Mountains, Saidor Subdistrict, Naho-Rawa Div., *Jermy* 4014 (BM). Northern Distr., Tufi subdistr., Lake Ridubidubina, *Hoogland* 4495 (L). **Eastern Highlands.** Chimbu. Pindaunde Valley, *Aptroot* 31382 (Herb. Aptroot); Lake Aunde, 3600 m, *v. Balgooy* 316 (Herb. Aptroot); Mt Wilhelm, *Kashiwadani* 10881, 10883, 10915, 10919, 10937, 10953–4, 10957, 11079, 11081, 11168, 11391, 11411 (TNS); Imbuka Ridge, *Weber & McVean* (COLO). **Morobe.** Saruwaged Range, *Sipman* 24383, 24470 (B); near Honzeukngon village, *Aptroot* 17851, 18018, 18020, 18022 (Herb. Aptroot); Herzog Mountain, *Streimann & Umba* 11032 (CBG). **Southern Highlands.** Iaro River, *Streimann* 23824 (CBG). **Western Highlands.** Nebilyer River, 2760 m, *Streimann* 20600 (CBG); Milne Bay. Woodlark Island, *Kumei* 43–4 (CBG). **Solomon Islands: Guadalcanal.** Mt Popomansiu, *Hill* 9403, 9617 (BM). **Fiji: Viti Levu.** Naitasiri, northern portion of Rairaimatuku Plateau between Mt Tomanivi and Nasonggo, *Smith* 5755 (BM, L, US). **Samoa: Upolo.** Lake Lanoto'o, *Schultz-Motel* 3425 (B); mountains east of Tiave, *Schultz-Motel* 4042 (B); Lanotoo, *Rechinger* 3100 (W). **Savai'i.** Lake Mafane, *Bartlett* 32149, 32153, 32155, 32156 (AK, BM).

27. ***Pseudocyphellaria stenophylla*** (Müll. Arg.) D.J. Galloway in *Lichenologist* 17: 306 (1985). *Sticta stenophylla* Müll. Arg. in *Flora, Jena* 65: 293 (1897). Type: New Caledonia, Mt Mu, 1886, *Vieillard* (G 002010-holotype). Fig. 33.

*Pseudocyphellaria prolificans* var. *angustata* Räsänen in *Suomal. elain-ja kasvit. Seur. van. kasvit. Julk.* 20(3): 16 (1944). Type: New Caledonia, ad corticem arboris, 1863(–64), *E. Vieillard* (H-lectotype, selected here).

*Thallus* irregularly spreading, often rather sparse, 2–4(–6) cm diam, loosely to closely attached centrally, margins free and ± ascending. *Lobes* very narrow, 0.1–0.5(–1.5) mm wide, 2–8(–15) mm long, irregularly linear-laciniate, subdichotomously to irregularly branching, ± free at apices, entangled centrally, plane to canaliculate (most noticeable in young, marginal parts). *Margins* entire, slightly thickened above, without isidia, phyllidia, pseudocyphellae or soredia. *Upper surface* bright lettuce green when wet, pale green-grey to pale olivaceous buff when dry, fragile, rather brittle when dry, pliable when wet, without isidia, maculae, phyllidia, pseudocyphellae or soredia. *Medulla* white, photobiont green. *Lower surface* pale whitish buff at margins to pale yellow-brown or red-brown centrally, glossy, glabrous or very sparsely and minutely tomentose in central parts, with a narrow, raised midrib in older parts. *Pseudocyphellae* white, rounded, punctiform, 0.1 mm or less, most common at margins, rather sparse and widely scattered centrally.

*Apothecia* and pycnidia not seen.

**CHEMISTRY.** 7β-acetoxypopane-22-ol, hopane-7β, 22-diol (tr.), hopane-15α, 22-diol and gyrophoric acid.

**OBSERVATIONS.** *Pseudocyphellaria stenophylla* is characterized by a white medulla; scattered, fleck-like, white pseudocyphellae on the lower surface but not present at the

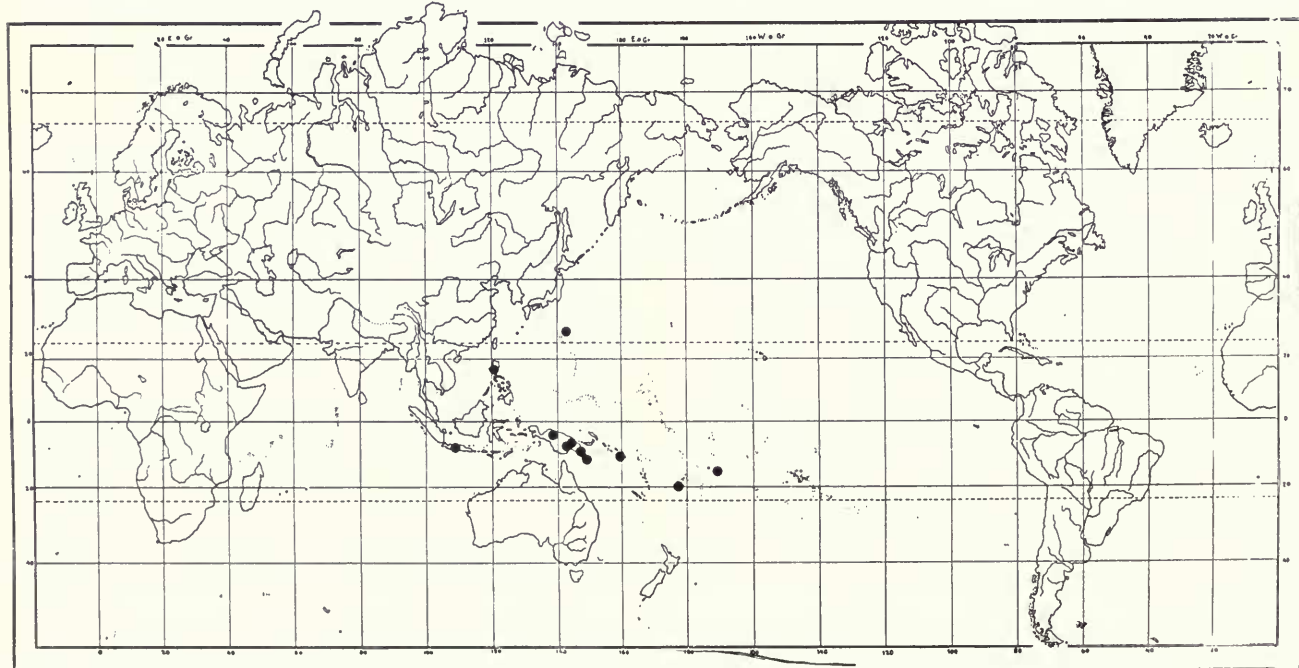


Fig. 32 Distribution of *Pseudocyphellaria semilanata*.



Fig. 33 *Pseudocypbellaria stenophylla*. Holotype (G 002010). Scale in mm.

margins; a green photobiont; a naked lower surface which is  $\pm$  costate centrally; very narrow lobes which are subdichotomously to intricately branched; and unthickened margins which are neither isidiate nor phyllidiate. It has a two-hopane chemistry with gyrophoric acid. Its very narrow lobes distinguish it from *P. sulphurea*.

**DISTRIBUTION AND ECOLOGY.** Known in the region only from the type collections in New Caledonia. Also in Australia (Queensland).

**SPECIMENS EXAMINED.** **New Caledonia:** known only in the region from the type specimens (see above).

28. *Pseudocypbellaria sulphurea* (Schaer.) D.J. Galloway in *Lichenologist* 17: 306 (1985). *Sticta sulphurea* Schaer. in Moritzi, *Syst. Verz.*: 127 (1846). Type: Java, sine loco. Zollinger 1860x (L 910, 182–20-lectotype (Galloway, 1985b: 306)).

Fig. 34.

*Sticta richardi* var. *impressa* Meyen & Flot. in *Nova Acta Acad. Leop. Carol.* 19, Suppl.: 216 (1843). Type: Manillae, ad truncos sylvarum, ad Meyen (L 019,211–1788-lectotype (Galloway, 1985: 306)).

*Sticta quercifolia* Taylor in *Lond. J. Bot.* 6: 177 (1847).

- Pseudocyphellaria quercifolia* (Taylor) Vain. in *Philipp. J. Sci. sect. C, Bot.* **8**: 117 (1913). Type: Sri Lanka, sine collectoribus nomine, no. 40, ex Herb. Hook. (BM-holotype; H-isotype).
- Sticta dissimulata* Nyl., *Syn. meth. lich.* **1**(2): 362 (1860). *Crocodia dissimulata* (Nyl.) Trevis., *Lichenotheca veneta* exs. 75 (1869). *Lobaria dissimulata* (Nyl.) Kuntze, *Revis. gen. pl.* **2**: 876 (1891). *Pseudocyphellaria dissimulata* (Nyl.) Vain. in *Philipp. J. Sci. Sect. C, Bot.* **8**: 118 (1913). Type: Java, sine loco, sine collectoribus nomine (H-NYL 33517-lectotype (Galloway, 1985b: 307)).
- Sticta punctulata* Nyl., *Syn. meth. lich.* **1**(2): 364 (1860). *Crocodia punctulata* (Nyl.) Trevis., *Lichenotheca veneta* exs. 75 (1869). *Lobaria punctulata* (Nyl.) Kuntze, *Revis. gen. pl.* **2**: 876 (1891). Type: Java, sine loco, Zollinger 1799 pr.p. (H-NYL 33481-lectotype (Galloway, 1985b: 307)).
- Sticta demutabilis* Kremp. in *J. Mus. Godeffroy* **1**(4): 98 (1874). *Pseudocyphellaria demutabilis* (Kremp.) Gyeln. in *Revue bryol. lichén.* **6**: 173 (1933). Type: Samoa, Savai, mont. veg ad arbores, *E. Gräffe* 106 (M-holotype; W-isotype).
- Sticta demutabilis* f. *laevis* Kremp. in *J. Mus. Godeffroy* **1**(4): 98 (1874). *Pseudocyphellaria dissimulata* var. *laevis* (Kremp.) Szatala in *Annl. hist.-nat. Mus. natn. hung.* **7**: 40 (1956), comb. inval. (Art. 33.2). Type: Samoa, Ins Upolu, *E. Gräffe* 101 (M-lectotype (Galloway, 1985b: 307)).
- Sticta demutabilis* f. *minor* Kremp. in *J. Mus. Godeffroy* **1**(4): 98 (1874). Type: Samoa, Savai, *E. Gräffe* 109 (M-holotype).
- Sticta karstenii* Müll. Arg. in *Flora, Jena* **64**: 505 (1881). *Pseudocyphellaria karstenii* (Müll. Arg.) Szatala in *Annl. hist.-nat. Mus. natn. hung.* **7**: 40 (1956), comb. inval. (Art. 33.2). Type: Novae Hollandiae [Australia], North Queensland, Bellenden Ker Range, *Karsten* 2, comm. F.v. Mueller 1881 (G 002020-holotype).
- Sticta leucophylla* Müll. Arg. in *Flora, Jena* **72**: 506 (1889). *Pseudocyphellaria leucophylla* (Müll. Arg.) Szatala in *Annl. hist.-nat. Mus. natn. hung.* **7**: 39 (1956), comb. inval. (Art. 33.2). Type: New Guinea, near summit of Owen Stanley Range, *Sir W. Macgregor* 6 pr.p., comm. F. v. Mueller 1889 (G 002116-holotype).
- Pseudocyphellaria dissimulata* var. *hypophaea* Vain. in *Philipp. J. Sci. Sect. C, Bot.* **8**: 118 (1913). Type: Philippines, Mindanao, District of Zamboanga, ± 1200 m alt., on trees, Nov.–Dec. 1911, *E.D. Merrill* 8351 (TUR-VAINIO 10195-lectotype, selected here).
- Pseudocyphellaria dissimulata* var. *nudior* Vain. in *Philipp. J. Sci. Sect. C, Bot.* **8**: 118 (1913). Type: Philippines, Negros, Canlaon Volcano, 5000 ft, on trees, April 1910, *E.D. Merrill* 6889 (TUR-VAINIO 10191-lectotype, selected here).
- Pseudocyphellaria dissimulata* var. *curranii* Vain. in *Philipp. J. Sci. Sect. C, Bot.* **8**: 119 (1913). Type: Philippines, Luzon, Prov. of Pampanga, Mt Arayat, ad truncum arboris, March 1910, *H. M. Curran* 19341 (TUR-VAINIO 10193-holotype).
- Thallus* irregularly spreading, often in large, entangled clones, 10–20(–35) cm diam., loosely attached centrally, apices free, ± ascending. *Lobes* very variable (1–)3–8(–12) mm wide, (1–)2–8(–12) cm long, linear-elongate, ± dichotomously branching, contiguous or discrete, apices usually free, ± divergent, rounded, pointed, truncate or furcate, complex-

entangled-imbricate centrally. *Margins* entire, smoothly rounded, conspicuously thickened-ridged above and below, here and there with occasional white pseudocyphellae. *Upper surface* bright lettuce-green when wet, occasionally suffused red-brown at apices and margins, pale grey-green, olivaceous to fawnish or red-brown when dry, shining, conspicuously dimpled, punctate-impressed to ± shallowly faveolate, smooth in parts or faveolate but generally strongly punctate-impressed, tough, coriaceous to thin and somewhat papery, without isidia, maculae, phyllidia, pseudocyphellae or soredia. *Medulla* white. *Photobiont* green. *Lower surface* pale whitish to pale yellow-brown or pinkish buff, noticeably wrinkled-ridged, thinly tomentose from margins to centre or ± glabrous, tomentum short, velvety to wispy, whitish to pale buff. *Pseudocyphellae* common, scattered, white, fleck-like, minute at margins, round to irregular centrally, to 0.5 mm diam., margins very slightly raised, concolorous with lower surface, decorticate area flat.

*Pycnidia* frequent to somewhat sparse, mostly marginal in short lines or in clusters, punctate, 0.1 mm diam. or less, ostiole red-brown to black.

*Apothecia* absent to occasional to ± frequent, marginal and submarginal, sessile, constricted at base, rounded, 0.5–2.5(–4.5) mm diam., exciple pale pinkish fawn to yellow-brown, translucent when wet, persistent, coarsely scabrid-areolate, disc subconcave to plane, smooth, matt, pale to dark red-brown, epruinose. *Epithecium* pale yellow-brown, 9–15 µm thick. *Hymenium* colourless, 70–95 µm tall. *Ascospores* 1-septate, yellow-brown to red-brown, fusiform-ellipsoid, (22–)25–28(–30.5) × 6.5–8(–11) µm.

CHEMISTRY. 7β-acetoxypopane-22-ol, hopane-7β, 22-diol (tr.), hopane-15α, 22-diol as constant compounds, with or without some or all of the following as accessory compounds: tenuiorin, methyl gyrophorate, gyrophoric and congyrophoric acids (specimens with gyrophoric acid in quantity give a positive C+ pink medullary reaction).

OBSERVATIONS. *Pseudocyphellaria sulphurea* is a widespread palaeotropical species having a white medulla, a dimpled, punctate-impressed upper surface (not or very rarely truly faveolate) with conspicuously thickened margins below, and scattered, fleck-like, white pseudocyphellae on the lower surface.

In Schaerer's description of *Sticta sulphurea* he mentions '... intus sulphureis' (i.e. yellow medulla) in the account of specimen Zollinger 1860x on which he based the name. However, examination of authentic Zollinger material from Java bearing this number failed to reveal any yellow medulla and it is not clear why Schaerer mentioned *sulphureis* in his description. The Zollinger material which bears Schaerer's name has a uniformly white medulla, characteristic of the species, but on all other counts the material fits Schaerer's description precisely.

*P. sulphurea* is distinguished from *P. stenophylla* by its wider lobes which are thickened at the margins of the lower surface; from the New Zealand endemic *P. rufovirescens* by the characteristic punctate-impressed, dimpled upper surface and the presence of the depside gyrophoric acid; from *P. prolificans* and *P. multifida* by lacking marginal or laminal phyllidia, isidia or proliferations; and from *P. beccarii* which has a similar morphology but has a cyanobacterial photobiont. Photosymbiodemes of *P. sulphurea* and *P. beccarii*, although reported in the literature (James & Henssen, 1976)



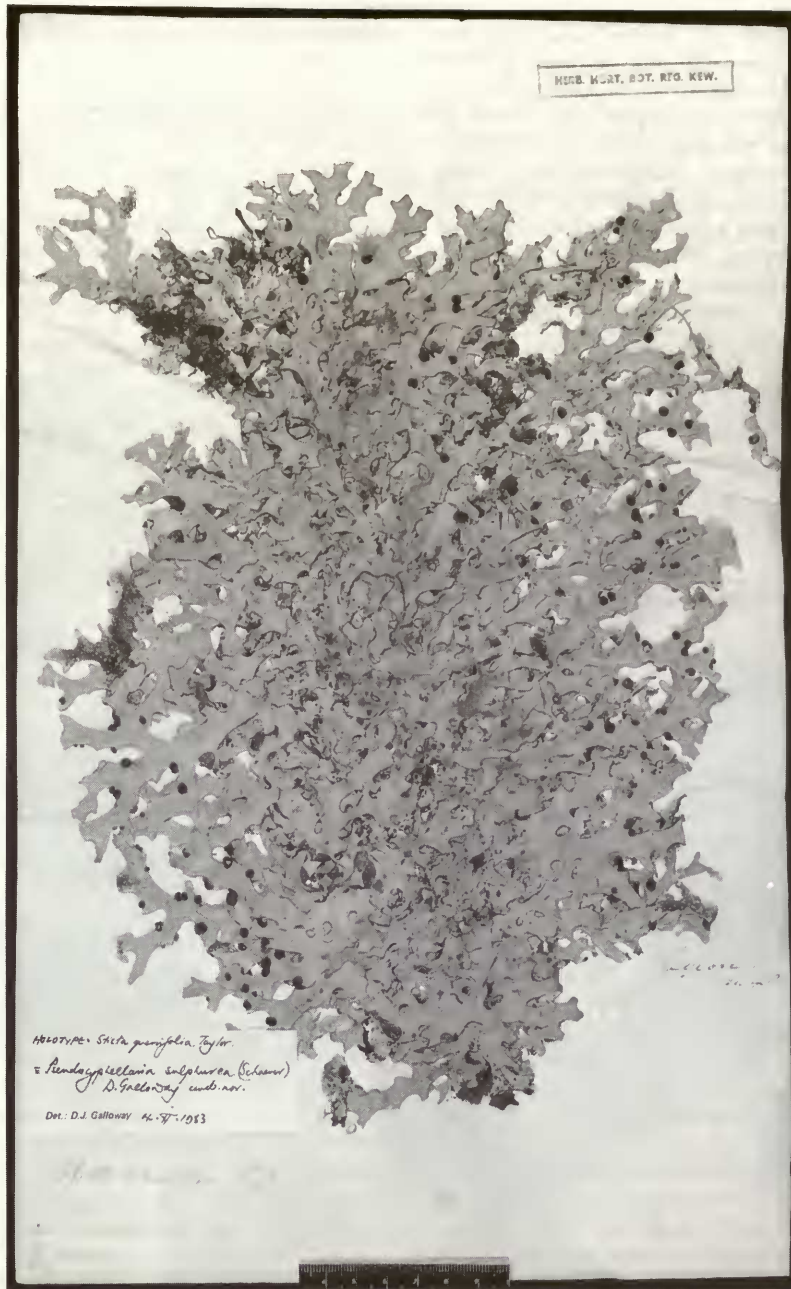


Fig. 34 *Pseudocypbellaria sulphurea*. Holotype *Sticta quercifolia* (BM). Scale in mm.

have not been seen by the present author.

**DISTRIBUTION AND ECOLOGY.** One of the most common and widespread of palaeotropical lichens (Fig. 35) growing as an epiphyte of branches and trunks of trees and shrubs in dense, humid, mossy montane forest and cloud forest, often forming large mats, also on scattered subalpine trees and shrubs in alpine grassland, 700–3600 m.

**SPECIMENS EXAMINED.** **Madagascar:** Ambohinutombo forest, *Forsyth Major* 457 (BM); Toshimaniko forest, *Forsyth Major* 96 (BM). **Sri Lanka:** Kandy, *Moon* (BM); sine loco, *Macrae* 131 (BM); Central Province, *Thwaites* C.L. 22 (BM). **Thailand:** Prov. Nakawng Li Thammarat, Khao Luang, *van Beusekom* s.n. (Herb. Aptroot). **Malaysia:** Pahang. Gunong

Hyan, Perak, *Wray* (BM). **Singapore.** Sine coll. 6689 (BM). **Sabah.** Mt Kinabalu, near HQ of National Park, *Ding Hou* 207 (Herb. Aptroot); Mt Kinabalu, *Sipman & Tan* 31085, 31377a (B); 3000 m, *Polak* (B); *Lee* (COLO); Mesilau River, *Hale* 28113, 29194, 29256, 29290 (TNS). **Indonesia.** **Sumatra:** Mt Korinchi, 7300 ft, *Robinson & Kloss* (W); sine loco, *Korthals* (L); sine loco, *Forbes* (BM). **Java:** Salang, v. *Goebel* (M); Prov. Batavia, in monte Megamendong, *Schiffner* 3386 c (M, W); Pamaboela bei Toegoe, *Kurz* (M); Mt Ardjuno, trail from Sumber Brantas Estate to Mt Kembar, *Groenhart* 9856 (Herb. Aptroot); Mt Gede, Tjibodas, *Groenhart* 1807 (L); sine loco, *Weiss* 4517 (B); sine loco, *Laurer* (B); *Junghuhn* (B); Malang, *Lederer* (B); Palang, v. *Goebel* (W); sine loco, *Reinwandt* (B). Mt Gede, *Palmer & Bryant* 1091, 1242 (US);

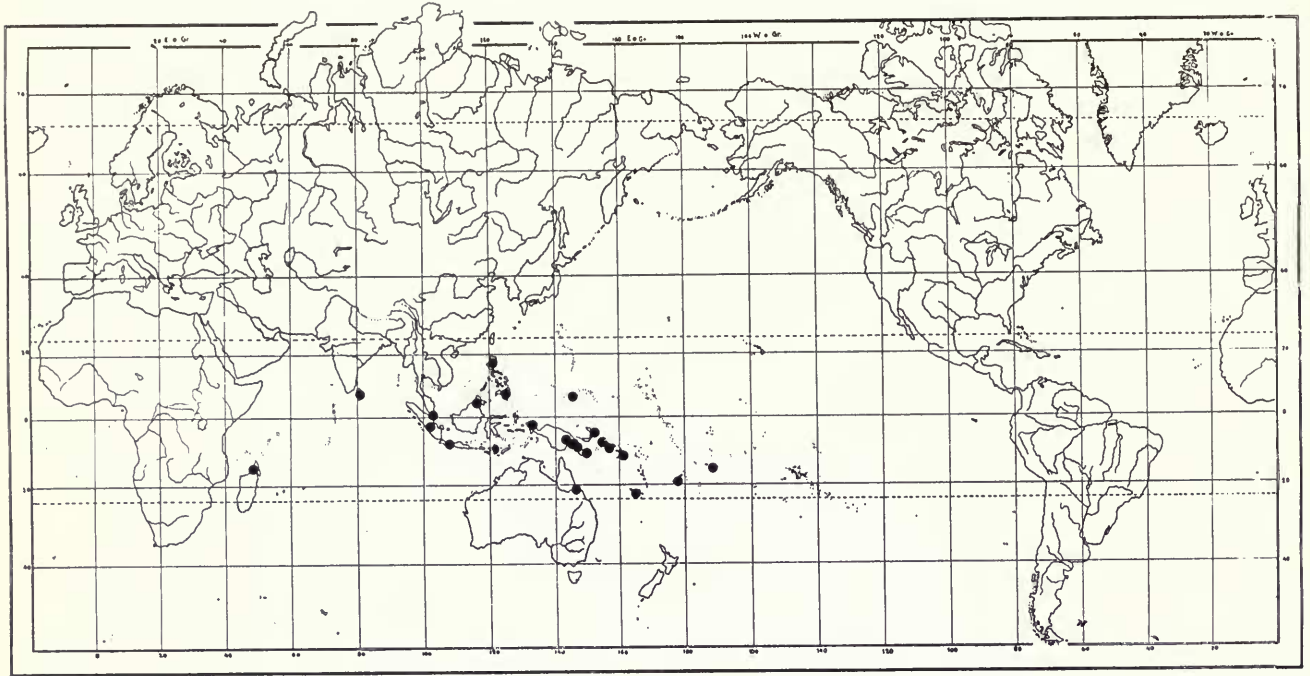


Fig. 35 Distribution of *Pseudocypbellaria sulphurea* in the palaeotropics.

**Flores:** sine loco, 1970, *J.A.J. Verheijen* 2729 (Herb. Aptroot). **Philippines: Mindanao.** *Elmer* [Kryptogamae exsiccatae editae a Mus. Hist. Nat. Vindobon. 2841] (M, B); Mt Batangan, *Warburg* 14214a (B); Mt Apo, *Mearns* s.n. (US); Davao. Mt Apo, *Elmer* 11535 (W); sine loco, *Mearns* s.n. (W); *Elmer* (BM, W). **Luzon.** Benguet, Baguio, *Elmer* 83; Pampanga. Mt Pinatubo, *Elmer* 21939 (B); Benguet. Baguio, *Elmer* s.n. (US); Mt Tonglon, *Ramos* s.n. (US); *Curran* s.n. (US); ?Fayobos. Mt Banohas, *Elmer* 7565 (W). **Mindoro.** Mt Halcon, *Sales & Wijangco* 10 (B); *Merrill* s.n. (US). **Camarines.** Mt Isarog, *Ramos* 6042 (BM). **Caroline Islands: Ponape.** Mt Erica, *Cheatham* 27 (B); Mt Tamantamansakir, *Glassman* (W). **Irian Jaya: Vogelkop Peninsula, Tamrau Range, Gunung Bagimana, van der Zon s.n. (Herb. Aptroot); Vogelkop Peninsula, Nettoti Range, Wekari River camp, *van Royen & Sleumer* 8145 (Herb. Aptroot). **Papua New Guinea: East Sepik.** Kairuru Island, *Borrell* 3 (CBG). **Madang.** Huon Peninsula, Finisterre Range, Yupna Valley, Teptep Village, trail NNW towards Bambu, *Aptroot* 31919, 32000, 32009 (Herb. Aptroot). **Morobe.** Track to Mt Missim, *Broome* 89A, 208 (CBG, B); *Bellamy* 201, 202b, 204a, 207–8, 208a, 1392, 1453 (B); *Streimann* 18511 (CBG); Mt Sarawaket [Saruwaged] Southern Range, *Koponen* 32872 (Herb. Aptroot); Monkumbion, *Hoogland* 9764 (BM); Cromwell Mountains, *Koponen* 31200 (Herb. Aptroot); Spreader Divide, *Schodde & Craven* 4944 (Herb. Aptroot); Edie Creek Road, *Sipman* 15621 (B); Skindiwai, *Kairo* 391 (CBG); Ekuti Divide, *Rau* 697, 701, 704–5 (CBG); Kauwara River, *Kairo* 670, 672 (CBG); Eraulu Logging Area, *Kairo* 318 (CBG); Mt Missin, *Kashiwadani* 10405, 10410 (TNS); Mt Kaindi, *Kashiwadani* 10454 (TNS); *Streimann* 24817, 33281 (CBG); 7 km SE of Bulolo, *Kashiwadani* 10808 (TNS); Herzog Mountains, *Streimann & Umba* 10962, 11100 (CBG); Gumi Divide, *Streimann* 22712 (CBG). **Southern Highlands.** Tari, Mt Ne, *Kalkman* 4866 (Herb. Aptroot); Tari Gap, *Lambley* (BM); Lama Sawmill Logging Area, *Streimann***

24710 (CBG); Munia Logging Area, *Streimann* 23212 (CBG). **Eastern Highlands.** Chimbu, Imbuka Ridge, *Weber & McVean* (Herb. Aptroot); track to Mt Wilhelm, *Sipman* 21922, 21929 (B); Mt Wilhelm, *Borgmann* 719, 732, 805 (B); *Kashiwadani* 10838, 10847, 10867, 10890, 10944, 10961, 11038, 11187, 11195, 11206, 11349, 11414 (TNS); near Hogabi Village, *Streimann* 18615, 18662, 18694 (CBG); track to Mt Michael, *Streimann* 18789, 18828 (CBG); Goroka, Gahavisuka Provincial Park, *Streimann & Kairo* 18184, 18227 (CBG). **Central District.** Mt Wosa, *v. Royen* NGF 20269 (Herb. Aptroot); Mt Albert-Edward, *Kashiwadani* 11747, 11768, 11780, 11809, 11823, 11934, 12001, 12012, 12293 (TNS); 2 km N. of Waiotape Airstrip, *Kashiwadani* 12262 (TNS). **Western Highlands.** Laiagam, Yobobos, *Hoogland & Schodde* 7639b (B). **Milne Bay.** Mt Moiba, *Pullen* 7742 (Herb. Aptroot). **New Ireland:** Hans Meyer Range, *Sands* 1917 (BM). **Solomon Islands: Kolombangara Island.** Ridge west of Kolombangara River, *Hill* 10508, 10537, 10577, 10679, 10603, 10605, 10674 (BM); South Summit, *Hill* 10484–5, 10490 (BM); Poitete, *Glenny* 2280 (BSIP); Irii, *Glenny* 2403 (BSIP). **Guadalcanal Island.** Mt Popomansiu, *Hill* 9286–7, 9330, 9376, 9436, 9443, 9445, 9477, 9478–82, 9482a, 9514–6, 9518, 9567, 9569–70, 9573–4, 9582, 9583–5, 9676, 9678, 9688, 9691, 9696, 9701–3, 9707–8, 9710, 9712, 9719, 9721, 9803, 9829–30, 9835–8, 9857–61 (BM); Mt Gallego, *Hill* 8170 (BM). **Bougainville:** south rim of Lake Loloru crater, 20 miles N. of Buin, *Craven & Schodde* 336 (Herb. Aptroot). **New Caledonia:** *Roberts* (MEL); sine loco, *Compton* 1729 (BM). **New Hebrides: Aneityum.** Sine coll. (BM). **Fiji: Viti Levu.** N-bulti trail, *Selling* (S); Nadarivatu, *O. & I. Degener* 31812e (Herb. Aptroot; B); Mt Victoria, *Green* (BM); *Lam* 6832 (BM); Novai, *Degener* 31815 (B); ridge from Mt Namama to Mt Tomanivi, *Smith* 5712 (US); Ngau, Herald Bay, *Smith* 7828 (US); sine loco, *Horne* (BM); *Milne* (BM). **Samoa: Upolu.** Near Lake Lanoto'o, *Schultz-Motel* 3309 (B); Mt Lanuto'o, *Rechinger* (B, W); Mt Fiamoe,

*Schultz-Motel* 4251 (B); Viti Savai, *Graeffe* (BM); sine loco, *Powell* (BM). Savai'i. *Reinecke* (WU); ?Tutuila, *Reinecke* (WU).

29. *Pseudocypbellaria trichophora* (Vain.) D.J. Galloway, **comb. nov.**

Fig. 36.

Basionym: *Sticta trichophora* Vain. in *Philipp. J. Sci. Sect. C, Bot.* **8**: 123 (1913). Type: Philippines. Mindanao, Camp Keithley, Lake Lanao, September–October 1907, *Mary Strong Clemens* 1304 (US-isotype).

*Thallus* orbicular to irregularly spreading, 10–12(–15) cm

diam., loosely to closely attached centrally, free and  $\pm$  ascending at margins and apices. *Lobes* linear-elongate (3–)5–8(–12) mm wide, 2–6(–8) cm long, attenuating at apices which may be blunt, rounded or shallowly furcate,  $\pm$  dichotomously branching, sinuses prominent, thickened. *Margins* entire, conspicuously thickened-ridged above and below, with prominent white pseudocypbellae, tomentose, especially at or near apices, tomentum white, silky. *Upper surface* dark leaden grey or grey-blue, suffused brownish at margins when wet, pale greyish fawn when dry, tough, coriaceous, smooth or minutely and shallowly wrinkled in parts, plane to  $\pm$  canaliculate, isidia, phyllidia and soredia absent. *Pseudocypbellae* present, minute, 0.1 mm diam. or



Fig. 36 *Pseudocypbellaria trichophora*. Isotype (US). Scale in mm.

less, white, punctiform, very widely scattered, inapparent. *Medulla* white. *Photobiont* cyanobacterial. *Lower surface* uniformly thickly tomentose from margins to centre, tomentum dense, woolly-entangled, pale fawnish buff at margins to dark brown or blackened centrally. *Pseudocyphellae* white, prominent (especially at lobe margins), rounded, 0.1–1 mm diam., conical verruciform, margins raised, sharply defined, glossy, decorticate area flat to concave.

*Pycnidia* not seen.

*Apothecia* very rare, marginal or submarginal, rounded, cupuliform to 2.5 mm diam., sessile, constricted at base, exciple coarsely wrinkled-scabrid, pale buff-brown, translucent when wet, with white silky hairs prominent below, disc concave to plane, smooth, shining, red-brown, epruinose. *Epithecium* red-brown, 14–20 µm thick. *Hymenium* pale straw or colourless, 90–110 µm tall. *Ascospores* pale red-brown, 1–3-septate, ellipsoid, apices rounded or pointed, 18–25 × 7–11 µm (Vainio (1913: 122) gives spore dimensions as 44–50 × 4–6 µm).

CHEMISTRY. 7β-acetoxypopane-22-ol, hopane-7β, 22-diol (tr.), hopane-15α, 22-diol.

OBSERVATIONS. *Pseudocyphellaria trichophora* has linear-elongate lobes and a coriaceous upper surface which is ± canaliculate towards margins and apices and is devoid of isidia, phyllidia and soredia, but which has rather sparse, white punctiform pseudocyphellae. It has a white medulla, a cyanobacterial photobiont, tomentose lobe margins (especially at apices), a densely tomentose lower surface with conspicuous white pseudocyphellae with raised, narrow margins resembling true cyphellae. It has a two-hopane chemistry. It is distinguished from *P. semilanata* by the tomentose lobe margins and the nature of the pseudocyphellae, and from the New Zealand endemic *P. allanii* (Galloway, 1988) by the scattered pseudocyphellae on the upper surface.

DISTRIBUTION AND ECOLOGY. At present known only from the Philippines and Papua New Guinea. Still very much under-collected. From humid montane rainforest at 1500 m.

ADDITIONAL SPECIMEN EXAMINED. **Papua New Guinea: Morobe.** Aiuwa-Bakia Track, *Streimann & Tamba* 12290 (CBG).

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